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STRANGULATION OBSTRUCTION

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INTRODUCTION

THE STUDY of the cause of death in strangulation intestinal obstruction has been pursued from many different aspects. The advent of antibacterial agents suggested several new approaches to the problem and reawakened interest in certain phases of the problem which could not otherwise be attacked. Much recent work has suggested that some previously accepted ideas might now be disputed, or even disproved. A critical reappraisal of the literature seemed to be indicated, therefore, to permit clarification of some of the older concepts in the light of more recent knowledge.

Great advances in the study of intestinal obstruction have resulted from certain major contributions in the past. The separation of simple from strangulation obstruction, which was first emphasized in 1911 by Murphy and Vincent (118) and in 1913 by Wilkie (178, 179), and which was afterward confirmed by many other workers (65, 80, 82), was a significant step in the evolution of knowledge about intestinal obstruction. Recognition in 1928 of the differences between high and low intestinal obstruction (65, 115) aided further in establishing cause and effect relationships. The significant contributions from 1912 to 1928 of Hartwell and Hoguet (80, 81), Haden and Orr (68, 69, 70, 71, 72, 73, 126), and Gamble (62, 63, 106), showing the importance of water and salt replacement, were an important milestone in the study of intestinal obstruction. The subdivision of strangulation obstruction according to the length of the strangulated segment, beginning in 1924, was a major advance (60, 88). This made possible the elimination of those experimental conditions in which death was caused by shock from excessive blood loss, as in the long loops, and by peritonitis, as in rupture of the short loops. Segments of medium length could then be studied further, with the number of variables reduced.

Throughout this period, the question of a bacterial factor repeatedly arose and was reevaluated and then dropped into the background when some other factor appeared to have greater significance. The very persistence with which the role of bacteria reappeared should arouse some suspicion of their importance. The excellent reviews of Cooper (40) in 1928 and Besser (14) in 1940 were unable to exclude a bacterial factor in strangulation obstruction after careful surveys of all data available. As the result of a new light shed on the problem by the use of

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antibiotics, the bacterial factor once again seems to be gaining in importance. In this light, reappraisal of some of the problems seems to be worthwhile, and is undertaken here.

BACTERIAL FACTOR ALONE

Williams, in 1926, in a pioneer and now classical article in this field, maintained that the fatal outcome of strangulation obstruction was due to exotoxins of the Clostridium welchii (180). Although this work was disputed (75, 88, 107, 125, 127, 128, 159, 160), Williams was not alone in maintaining that the fatal outcome was due to these exotoxins as part or all of his work has been confirmed (19, 41, 116). Others have shown that the fatal outcome in strangulation obstruction requires the presence of bacteria (2, 5, 16, 17, 18, 24, 44, 50, 77, 78, 117, 118, 139, 140, 142).

Williams (180, 181) pointed out that growth of the Clostridium welchii in the normal intestine was hindered by changes in the *p*H throughout the gastrointestinal tract and by the rapidity of transit through the small intestine where conditions were ideal. On the other hand, the obstructed small bowel presents an ideal *p*H, ideal anaerobic conditions, and sufficient time for its growth. In pyloric obstruction, gastric acidity prevents its proliferation and in large bowel obstruction, acid conditions also prevail. Williams postulated that bacteria could be detected above the obstruction and eventually in the vomitus, and he then demonstrated this in clinical cases. In contrast, the Clostridium welchii was not found in pyloric obstruction or in nonobstructive vomiting. Clostridia in large numbers were found in small intestinal contents in cases of obstruction, in contrast to the small number found in a man killed accidentally. Thus, Williams showed the tremendous increase in bacterial flora following small bowel obstruction. Since the only one of these bacteria known to produce a powerful exotoxin was the Clostridium welchii, he focused his attention on this organism.

The rapid quantitative increase in clostridia following obstruction was also shown by McIver, White, and Lawson (107), Armour and his associates (11), North (125), and Stabins and Kennedy (154). The last two workers compared cultures of a dog's bowel 10 inches below the ligament of Treitz before and after obstruction. Of these cultures, 17 per cent were positive for the Clostridium welchii at operation, compared to 95 per cent after obstruction. Simple obstruction 10 to 15 centimeters from the pylorus showed no Clostridium welchii in the stomach preoperatively (11). Postoperatively, growth was obtained from dilutions of 1 to 1000 up to 1 to 1,000,000,000. None of the animals had any ulceration, so there was no chance for absorption of the toxins, but it is interesting to note the concentration and tremendous increase of bacteria in the presence of obstruction, even in the unfavorably acid stomach.

North (125) cultured the bowel of dogs when obstruction was created, and again 5 days later. At operation, cultures were never positive for the perfringens group in dilutions greater than 1 to 10. By the fifth day there was tremendous proliferation with 2 cultures showing growth in dilutions of 1 to 1000, and 2 in 1 to 10,000. The importance of this in human beings is seen from the finding of the Clostridium welchii in the feces of 35 per cent of normal individuals (54).

Williams' attempts to demonstrate the exotoxin were perhaps the weakest part of his article. He found pathological changes in heart muscle and liver which were compatible with clostridial infections but which were not pathognomonic. Gas gangrene antiserum was tried clinically with striking results, the mortality rate dropping from 24.8 to 9.3 per cent in acute intestinal obstruction. Williams believed his findings were sufficient to show the relationship between Welch toxins and the symptoms in obstruction. Other workers have disputed these correlations.

Bower and Clark (19) also thought antitoxin was of benefit in obstruction. They noted the same improvements in the condition of patients immediately following the injection of antitoxin. By reducing the mortality rate from 90 per cent in untreated dogs to 35 per cent in dogs with previous Welch immunization, they demonstrated the role of the Clostridium welchii in peritonitis (113).

Copher, Stone, and Hildreth (41) prolonged survival with antitoxin in experimental intestinal obstruction, working with an isolated, closed loop of bowel. The loop ruptured in every control animal but it ruptured in only 4 of 14 treated dogs.

Scholfield (142) demonstrated the formation of a bacterial toxin, mainly welchii, in the obstructed segment and absorption through the portal circulation. He noted, as had Davis and Stone (43), that nontoxic, normal duodenal con-

tents became toxic on incubation, further showing the importance of bacterial action.

Davis and Stone (43) implicated bacteria by injecting freshly obtained and variously treated intestinal secretions. They reached the following conclusions: (1) that fresh intestinal secretions were nontoxic; (2) that fresh, heated secretions were nontoxic; (3) that nonheated secretions were not toxic if incubated under toluene and chloroform; and (4) that secretions incubated 18 hours produced symptoms similar to those of closed loop fluid. The various processes which excluded enzymes without simultaneously removing bacteria gave evidence of the importance of bacteria.

Cannon and the Dragstedts (28) tried to prevent the toxemia of obstruction in rats by feeding the rats diets known to produce an aciduric intestinal flora. Regardless of the initial flora, death uniformly occurred. Proteolytic organisms predominated at death. This was interpreted as proof of the importance of the bacterial factor.

David and Loring (42), using experimental peritonitis created by the intraperitoneal injection of bacteria and culture media, showed that, regardless of the bacteria originally implanted, the major effects were due to the early transition to a Clostridium welchii infection. This occurred with equal facility in rabbits, which do not usually harbor these organisms. The change was not necessarily due to the passage of welchii through the bowel wall, since the transition could also be produced in the extremities. Bacteria alone did not produce the infection, some culture media being necessary. The greater virulence of bacterial combinations was emphasized, as well as the increased virulence of Welch organisms in the presence of appropriate culture media.

Aird (2) showed that strangulation of a loop of small bowel of medium length caused death by bacterial toxins. This length eliminated death from the shock of excessive blood loss in long loops (1) and death from perforation in short loops. Infant guinea pig bowel (shown to be sterile by culture) was placed in the peritoneal cavity of cats without effect. Bowel with positive cultures from older guinea pigs caused death of the cat. The transudate from a strangulated loop was collected in a rubber bag, and injected into guinea pigs. Up to 24 hours the cultures were sterile and the fluid was without effect. After this the fluid usually contained "aerobes and anaerobes" (the seromuscular coat of the bowel *always* did) and it was uniformly fatal. The animals died in 2 to 8 hours with weakness, increased respiratory rate, and spasticity of the limbs. Autopsy did not reveal peritonitis, but did reveal marked hemorrhages in the duodenum and congestion of the spleen and liver (not all necessarily present in any one animal). Aird concluded that bacteria growing in the intestinal wall produced exotoxins which were absorbed from the peritoneum and thus caused death.

In closed loops or in strangulation obstruction the bacterial content determined the outcome (5). Sterile loops were without effect; heavily infected loops rapidly caused death by gangrene, perforation, and peritonitis; and mildly infected loops caused death by blood loss or infection.

Dragstedt *et al.* (50) in 1919 demonstrated the necessity of bacteria for the production of a toxic substance in a closed loop. Extremely toxic fluid could collect without effect in a closed loop, but injection of this fluid into another animal caused death rapidly, which showed that the toxins were not absorbed through normal mucosa. In excluding a nonbacterial origin of the toxin they stated: "The presence of bacteria in the lumen of the intestine is necessary for the production of the characteristic toxic substances and in their absence these substances do not form. . . . In the absence of food, gastric juice, bile or pancreatic juice, these bacteria can produce the characteristic toxic substances. . . ."

Aird (5) observed a sudden fall in the blood pressure and occasionally sudden death following rapid reduction of a simple obstruction of long standing. This was even more severe in strangulation obstruction. Also noted were a rise in the pulse and temperature, pallor, listlessness, excitement, and death. Experimentally, the pressure drop was not of nervous reflex origin, but was related to the absorption of toxic substances previously not being absorbed from the obstructed segment. Once the strangulation or distention was removed, tissue fluids were reabsorbed and the toxin acted. More dramatic results of the same kind were elicited with strychnine by Brown and Boruttau (as quoted by Aird), by Scott (145, 150), and by Sperling (153).

The various papers of Murphy, Brooks, Vincent, and their associates showed: (1) that the contents of an obstructed bowel are toxic; (2) that bacteria are necessary for the production of this toxin; (3) that neither living tissue, mucous

membrane, nor any of the secretions of the mucous membrane are necessary for the formation of the toxin; (4) that the toxin does not pass through normal mucosa; (5) that absorption of the toxin is more important than its production as the toxin is physiologically lost if it exists within a loop and is never absorbed; (6) that circulatory damage aids absorption; and (7) that symptoms may be correlated with the toxin formed in the obstructed intestine (24, 117, 118).

The absence of absorption from obstructed bowel with a normal mucosa was repeatedly demonstrated (12, 15, 74, 81).

Numerous workers (44, 98, 131, 132, 133, 139, 140) have shown that venous occlusion of a bowel loop without obstruction may not be fatal if adequate preoperative therapy with antibacterial agents has considerably reduced the bacterial flora. Time was allowed for the collateral circulation to develop and the bowel was able to maintain a normal appearance. Since the bacterial flora of the gastrointestinal tract was the only difference between treated and control animals, death of the controls was attributed to bacterial action. We shall return later to these important papers.

Harper, Blain, and their colleagues (16, 17, 18, 77, 78, 96) showed that in penicillin-protected, isolated loops of bowel (1) the wall was not destroyed by bacterial action, (2) bacteria did not grow rapidly if they grew at all, and (3) death did not necessarily occur, as it did in control animals. Again, the only difference was the bacterial content of the bowel. These authors thought distention was necessary for bacteria to gain a foothold. Penicillin prolonged life in strangulation obstruction, but death still occurred. The cause of death was not determined.

In spite of the mass of evidence, many workers do not agree that either a bacterial factor or a bacterial toxin is the cause of toxemia in obstruction. Some of the outstanding opponents of Williams' work will be mentioned.

McIver, White, and Lawson (107) were among the first to attack Williams. In small bowel strangulation obstruction in cats they were able to demonstrate great quantitative increases in organisms (specifically of clostridia) in the obstructed loop and were able to demonstrate clostridia in the peritoneal fluid, blood, and lymph. However, injection of clostridial toxin was without effect and they were unable to protect cats by antitoxin. We had no experience with cats; however, experience with dogs and rabbits (34) suggested certain questions. McIver and his associates used 0.3 cubic centimeter of a filtrate in a mouse weighing 20 grams; death occurred in 18 hours. They then injected 4 to 12.5 cubic centimeters over a 9 day period in a cat weighing 1.2 kilograms without effect. On a comparable basis this cat should have received 18 cubic centimeters at once. Furthermore, intramuscular injections in the cat further delayed absorption and effect. Later cats weighing 3.0 kilograms were given 1 to 8 cubic centimeters of the same toxin intravenously. Again on a weight-for-volume basis, these cats should have received 45 cubic centimeters of the toxin. Experience with dogs and rabbits has shown that much larger quantities of Clostridium welchii cultures or filtrates can be tolerated without effect, and repeated injections in the same animal rapidly produce an effective immunity (34). Peritoneal fluid, loop contents, various fractions of loop contents, and a "dialysate" of the loop were injected intravenously into normal cats by McIver and his associates. These fluids were all obtained 18 to 24 hours after operation when the animals were moribund. Peritoneal fluid in doses of 1 to 25 cubic centimeters was ineffective and therefore considered nontoxic. Our own work would indicate that this was too small a quantity in the majority of cases (34). McIver *et al.* found that crude loop contents were highly toxic. After centrifuging, the sediment was toxic, the supernatant fluid varying greatly. Berkfeld filtrates did not affect the blood pressure, but in view of the long time required for filtration, the known decrease in toxin concentration with filtration, and the unfavorable conditions surrounding filtration, conclusions based on this portion of the work must be carefully evaluated. The obstructed bowel was dialyzed in saline solution in an incubator for 2 hours, and injection of the dialysate gave a "depressor effect," either before or after boiling. Since Welch toxin is destroyed by heat, boiling was interpreted to mean that it had no part in the effects demonstrated. However, the result was not conclusive because any foreign substance might give a depressor effect. In summary, this work on the susceptibility of cats to Welch toxin seemed to show only that cats are highly susceptible to the injection of obstructed bowel contents, in which (by the McIver group's own admission) the concentration of Welch organisms was high.

The antitoxin studies likewise need careful scrutiny for a number of reasons: (1) the dead or dying tissue, an ideal culture media for clostridia, was left in place; (2) there was no supportive therapy in spite of hemorrhages in the peritoneal cavity and bowel and in spite of marked reduction in the blood volume; and (3) the type of obstruction used was the most rapidly fatal of all—a closed, high, strangulated loop. With all these features marshalled against the animal, it is small wonder survival was not increased. That the Clostridium welchii in the blood, lymph, and peritoneal exudate was merely a postmortem invasion or an antemortem phenomenon in a moribund animal was negated by the McIver group's own statement: "Autopsy was carried out immediately after death." Our experiments (29, 37, 119) show that this is not a postmortem change, but one that may occur within a very short time after operation.

Haerem, Dack, and Wilson (75) centrifuged the contents of closed jejunal loops from dogs for intravenous injection in mice in quantities of 0.2 to 0.5 cubic centimeter. Culture of the loops showed high concentrations of welchii. The inconsistent mortality rate, the small numbers of mice injected with each fluid sample, the small amount of fluid injected, and the small amount of antitoxin injected in controls all argue for a cautious interpretation of the results in this series.

Holt (88), like others (1, 2, 3, 4, 5, 58, 59, 60, 145, 146, 147, 149), split off the group of long loop strangulations and also excluded short loops. In loops of moderate length, death was not connected with the blood loss, but was due to a toxin which became evident 16 to 20 hours after operation and which was soon in sufficient quantity to cause rapid death. Holt agreed with Scott and Wangensteen (148) that the peritoneal fluid was not toxic unless the loop had ruptured or was about to rupture, or unless the fluid had a foul odor. He found the lumen contents highly toxic, but he did not believe that they were directly responsible for death because there were differences between the lumen contents and exudate. He believed that bacteria invaded the intestinal walls, produced toxins which were absorbed, and thus caused death. The toxin was considered a proteose, but the exclusion of Welch toxin by Berkfeld filtration and boiling is open to the criticisms previously mentioned. In spite of arguments against Welch organisms, Holt noted mucosal invasion by rapidly proliferating intestinal bacteria shortly after strangulation and rapid multiplication of proteolytic anaerobes in deeper tissue layers where growth conditions were ideal. He argued against himself in saying that "the toxic quality of the exudate in the later stages is the direct result of the action of the proteolytic organisms which have invaded the intestinal wall and tissue spaces in large numbers from the lumen. Chief amongst these organisms is the *B. welchii*, but the toxic qualities of [the] exudate appear to be due to substances akin to the proteoses and not to any bacterial exotoxin." Since none of this work has excluded Clostridium welchii toxin, this statement does not seem justified. It is interesting to compare this conclusion with the opposite conclusions reached by Aird (2, 5).

Several groups of workers—North (125), Oughterson and Powers (127), Owings and McIntosh (128), and Holt (89)—tried to eliminate Welch effects because Welch antitoxin failed to protect or further prolong the life of dogs with obstruction; but Morton and Stabins (116) argued in favor of Welch toxin because of prolongation of survival. In each of these studies simple obstruction was used; and, since present knowledge indicates that proper fluid, electrolyte, and protein therapy can prolong life indefinitely in simple obstruction (93, 94, 123, 130, 177), these experiments do not evaluate the efficacy of Welch antitoxin.

Oughterson and Powers (127) subjected the contents of isolated, closed loops to Berkfeld filtration for toxicity studies. Tests in large numbers of mice failed to give constant results. In view of the known loss of Welch toxin by filtration, one wonders why less than 2.0 cubic centimeters of filtrate was always utilized.

Owings and McIntosh (128) tried antitoxin protection in isolated loops. Each dog had a ruptured loop and peritonitis, so the results of experiments with these animals should be excluded, except to mention that antitoxin did not prevent rupture, peritonitis, or death. Small quantities of loop contents were injected in dogs with fatal results to prove that the loop contents contained a toxin. The dogs became sick and died within 8 hours. Dogs were immunized with perfringens toxin, but "no attempt was made to procure a maximum degree of immunity in these animals" before loop contents were injected to test the protection. In one series the immunized

dogs died in 12 hours, 4 days, and 5 days (one survived). In the other series the immunized dogs were dead in 4 hours. Loop contents repeatedly shown to have high concentrations of welchii were filtered only through gauze. This suggests that the dogs dying at 4 and 5 days might have died of a septicemia rather than a toxemia. One wonders if the dogs dying at 4 hours received more than the minimum lethal dose. Loop contents were also injected with and without "antitoxin" into pigeons, with uniformly fatal results. In evaluating this portion of the work, one must remember (1) that the pigeon is one of the most susceptible animals to Welch action, (2) that only enough antitoxin was injected to protect against 25 minimum lethal doses (MLD) of Welch toxin, and (3) that 1 cubic centimeter of loop contents was injected, containing enough noxious substance, bacteria, and bacterial exotoxins to set up ideal conditions for the growth, spread, and production of toxins of any Welch organisms that might be present. Comparisons of the anemia produced by loop toxin and Welch toxin should be scrutinized carefully because a standard dosage of Welch toxin was used for all dogs regardless of weight. A one-half lethal dose of Welch toxin was used, but there was no indication of the potency of the loop toxin in this respect. Thus, all conclusions except one require careful study. That one—that the MLD of loop toxin is a smaller quantity than the MLD of perfringens toxin—may be explained by the purity of the perfringens toxin versus the mixture of bacterial products, bacteria, intestinal secretions, and debris of the loop toxin.

Taylor, Weld, and Harrison (159) produced "sterile" Thiry fistulas. After several months the fistulas were closed and returned to the peritoneal cavity, whereupon most of the animals died within a few days. In 2 that were sacrificed, examination showed the loop to be filled with bacteria. There is no indication that anaerobic cultures were done. Experience with this type of loop indicates that it frequently is *not* sterile (31, 33). The length of the loop is never mentioned nor is any postoperative supportive therapy mentioned by Taylor and his coworkers. The clinical course of the dogs that died suggests distention of the loop. One can surmise that the loop was not distended and that the intestinal wall was not damaged or invaded by bacteria in the surviving animals, in contrast to the opposite effects, with full bacterial growth, in those that succumbed. That the symptoms occurred too suddenly to be of bacterial origin is not tenable, since death did not occur for 2 to 8 days. In addition, it should be remembered that a simple, closed, isolated loop will produce symptoms by distention and the sequelae of distention.

Herrin and Meek (83) distended Thiry fistulas with balloons at known pressures in an attempt to correlate death with distention. However, they concluded only that death was due to a loss of chloride. Following distention, secretion by these fistulas greatly increased. The chloride loss in this secretion was equal to one-third of the total body chlorides, or 74 per cent of the blood chlorides, which was sufficient in itself to account for the death of the animal. Either saline solution for intravenous use or 10 per cent saline solution placed in the fistula prolonged life. Modified fistulas which allowed all secretions and possible "toxins" to drain back into the intestine, permitted indefinite survival of the experimental animal, a fact which the authors said "precludes toxemia either from bacterial products or necrotic substances from the intestinal wall." Current knowledge indicates that this should be reinterpreted to emphasize the importance of the reabsorption of fluids and electrolytes returned to the gastrointestinal tract.

Taylor and his associates (159), utilizing Thiry fistulas with balloon distention, obtained fatal results in 20 to 54 hours and concluded that distention was a major factor in death following obstruction. The animals lost little or no fluid by vomiting and reportedly had neither chloride depletion, obstruction, nor peritonitis, and yet they died rather rapidly. This "disposed of the theories that a bacterial toxin or a toxic substance derived from bacterial action is concerned in the symptoms of intestinal obstruction." Two important points must be considered in view of this statement. First, there was no attempt to clear the bowel of bacteria before the distending tube was placed in position. Second, the experimenters utilized an intraluminal pressure of 80 to 110 millimeters of mercury, and the use of this tremendous amount of pressure without a description of the postmortem appearance of the intestinal wall must lead one to suspect damage to the intestinal wall and bacterial proliferation. In contrast to these relatively enormous intraluminal pressures, several other workers have shown that intraluminal pressures never reach this height without causing severe damage to

the bowel wall. One group (107) showed that pressure in a closed loop reached a maximum of 54 millimeters of mercury only after a few hours, at which time the loop was distended by bloody fluid poured into the loop as a result of capillary damage and an inadequate supply of oxygen. Another group (129) has shown that in simple obstruction in dogs pressure rarely rose above 50 centimeters of water, even with active peristalsis, but that under normal conditions the range was between 6 and 8 millimeters of water. In isolated loops, on the other hand, a top pressure of 70 centimeters of water was recorded. "A loop markedly distended by a pressure of 25 or 30 mm. of mercury has its circulation partially blocked. This is evidenced by necrosis on the antimesenteric border of the loop. . . . . The average high pressure is 39.5 cm. of water or 30.4 mm. of mercury" (26). Lawson and Chumley (103) obtained similar figures. Dragstedt, Lang, and Millet (51) observed cessation of the blood flow in the wall of the small bowel when distention equalled 55 to 65 millimeters of mercury.

Gatch, Trusler, and Ayers (64A) were able to correlate the blood flow through a loop with the distending pressure in the loop. Complete anemic stasis developed when the pressure in the bowel was equal to the arterial pressure.

Sperling, Paine, and Wangensteen (153A) found that pressures in an obstructed small bowel vary between 4 and 19 centimeters of water and noted that the sustained pressure in low ileal obstruction is seldom above 14 centimeters of water.

Even the higher figures of Van Zwalenberg (163) placed circulatory arrest at a lower pressure than was utilized by Taylor and associates. Gatch and Culbertson (64) found 20 millimeters of mercury distention produced complete anemia of the mucosa. Antoncic and Lawson (10) recorded maximum pressures of only 33 centimeters of water in obstructed loops. Pressures of 40 centimeters of water produced structural changes in the bowel wall (27, 153).

The work of Noer and his associates (123A, 124, 124A, 124B) emphasized the differences between the intestinal circulatory patterns in man and dog and the similarities between those of man and rabbit, which they thought should cast some doubt on the validity of the work in which dogs were used to study the intestinal circulation in relation to the problem in man. Intraenteric pressure of 70 millimeters of mercury prevented the filling of all vessels in the wall of the human intestine. Larger vessels filled with pressures of 20 to 30 millimeters of mercury, but complete capillary filling occurred only when the intraenteric pressure was less than 10 millimeters of mercury. If the vessels to the distended loop were divided, the vessels to the loop would not fill until the distention was eliminated. In the distended living rabbit intestine circulatory disturbances were found at pressures of 30 to 40 millimeters of mercury. Pressures of 50 millimeters of mercury or higher produced irreversible changes in the intestinal circulation, including interstitial hemorrhages and pronounced intravascular agglutination. Normal was taken as 0 to 5 millimeters of mercury, but changes began at 15 millimeters of mercury in the venules and by 30 millimeters there was pronounced slowing in the venules and small veins and cessation of function in many capillaries. Early cyanosis was noted at 40 millimeters of mercury. In view of the large amount of evidence pointing to bowel wall damage at these lower pressures, damage to the intestinal wall must be suspected in Taylor's work, and bowel wall damage even without perforation would open to re-evaluation this entire section of Taylor's paper.

By a study of India ink absorption, Stone and Firor (156A) showed that increased intraintestinal pressure aided absorption of intestinal contents even before it could produce damage to the mucosa or the wall of the bowel.

Sperling and Wangensteen (153B) found that increased intraintestinal pressure speeded up absorption of strychnine from a devascularized segment of bowel, but attributed this to increased permeability resulting from the increased pressure. In simple obstruction, they attributed the increased absorption to the damage which occurred in the bowel wall as a result of the distention.

Thurston (160) used simple, isolated, closed jejunal loops in control, antitoxin-protected, and immunized dogs. Survival in the treated, untreated, and immunized animals was the same. Because of the known distention with its attendant circumstances in this type of loop, the results do not seem to have a direct relation to the present problem. Loop content injected intravenously, both with and without antitoxin, gave the usual toxic symptoms with death in 1.5 to 12 hours. Since loop fluid contains numerous bac-

teria, highly concentrated Welch exotoxins, and jejunal contents, neutralization should not be anticipated from a volumetrically equal quantity of Welch antitoxin. In the surviving animals with isolated loops, the loop was shown to contain Welch organisms, although the dogs showed no serum antibodies. The intact loop mucosa prevented the organisms from invading the peritoneum and thus explained the survival of these animals. For these reasons Thurston's conclusions on the lack of correlation between fatality in intestinal obstruction and Welch toxin seem unjustified.

TISSUE AUTOLYSIS PRODUCTS

In contrast to the theory of Welch toxin origin of toxic symptoms in obstruction is the theory that tissue autolysis explains the symptoms. This stems mainly from autolysis of the strangulated portion and from observation of the intestinal mucosa in obstruction, all symptoms being linked with destructive changes there.

Andrews and Hrdina (7, 8) concluded that liver placed free in the peritoneal cavity caused death from autolytic products of the liver without the intervention of bacteria. However, autoclaving and chemical treatment of the liver may have altered it so much that its resemblance to normal tissue is questionable. Autopsy showed bloody peritoneal fluid; hemorrhages throughout the peritoneum; absence of fibrin or frank pus; engorgement of, and capillary hemorrhages in, the lungs; and friable, greasy, gas-infiltrated livers showing the advanced degeneration of a toxic hepatitis. Clostridium welchii, found in the peritoneal cavity in every fatal case, were considered a component of "autolytic peritonitis," but the authors did not believe the organisms were a contributing factor, since they were not introduced in the experimental procedure. Sterile bile salt solutions injected in various parts of the body created the same results, always with an overwhelming Clostridium welchii infection (9). The bacteria were thought to come from the tissues at the site of injection. When liver extracts were injected in the hind leg of dogs after wide tourniquet isolation of the limb, severe gas gangrene developed in the leg. It was concluded that liver extract destroyed the bactericidal powers of the tissues and allowed clostridia to grow. The papers of Andrews, Hrdina, and Rewbridge seem to be an argument for the potency and omnipresence of welchii and their importance in the presence of necrotic tissue. These authors (8) even pointed this out, noting that "local gangrene or severe tissue injury may permit an active infection by organism[s] previously lying dormant." The conclusion (136) that "bile peritonitis is an infection which is produced by *B. welchii* or some other anaerobic bacillus closely related to it" would seem to correlate all of their liver autolysis, bile, bile salt, and liver extract work.

Mason and Davidson (109, 110, 111) also studied intraperitoneal autolysis of isolated pieces of liver. Their autopsy findings were similar to those of Andrews and Hrdina, and many of their chemical observations were similar to those in strangulation obstruction (119). The survival time was not related to the size of liver used. Saline extract of autolyzed liver was highly toxic, but that of normal liver was not. The toxic agent increased the amplitude of respiration and produced a sudden fall in the blood pressure followed by a rise, an increase in the heart rate, and an arrhythmia. Death was attributed to action on the circulatory system and myocardium. The lethal effects of similar splenic experiments were neither so consistent nor so rapid because of the more uniform infection of the liver. Mason and Davidson concluded that all these effects were due to liver autolysis alone, but it now seems certain that they could be explained on the basis of Welch infection of the liver (55, 144, 182).

Mason and Nau (111A) showed a definite correlation between the toxicity of autolyzing liver and its bacterial content, even though they attributed the results to liberation of toxins from the liver tissue by the action of bacteria. They anticipated more recent work on the effect of antibiotics on hepatic anoxia by stating: "The bacteria remain in a latent state until stimulated to activity by the asphyxiation of the liver tissue."

The importance of bacteria in liver necrosis has been further emphasized recently by the extensive work which followed the report of Markowitz, Rappaport, and Scott (108) on the antibiotic protection of the liver following hepatic artery ligation. Several recent studies which have shown that the human liver is sterile in contrast to the contamination normally present in the dog liver (130A, 137A, 140A) might suggest that these findings should be interpreted somewhat differently in human beings than in dogs. However, the demonstration of the continual seeding of

both the dog and human liver by bacteria passing from the gastrointestinal tract through the portal vein indicates the importance of bacteria in human liver disease also (141A, 141B).

Wangensteen and Waldron (168) reported that since the poor prognosis in strangulation obstruction was due to tissue injury, "a study of strangulation obstruction, therefore, resolves itself into an inquiry into the autolysis of injured segments of intestine." Segments of intestine and other tissues were placed in the peritoneal cavity of normal dogs. "Tissues obtained from another animal did not seem to be of any special handicap in recovery." Similar tissues removed aseptically and autolyzed in saline solution in an incubator were injected intraperitoneally in normal rats (the unfortunate use of a different species was probably unavoidable because of the tremendous quantities of autolysates otherwise necessary). Liver and intestinal tissues were most toxic, splenic and renal tissues being slightly less toxic. Autopsy observations were similar in all experiments: 300 to 400 cubic centimeters of serosanguineous, peritoneal fluid; reddening of surface; autolyzed tissues friable, mushy, and often unidentifiable; and fibrinous exudate about the tissue. Since irrigation of the loop of the intestine was thought to make it bacteria-free, the rapid death was attributed to tissue autolysis. This is a highly debatable point, particularly since Dragstedt (53) had shown repeated washings to be ineffective for bowel sterilization, and in view of our own experience with bowel loops (38) and that of Laufman and his associates (100). If death occurred within 24 hours, as it usually did with intestine and liver, "the tissue was spongy and often contained gas" (168). Incubation and autolysis in vitro of the same tissues before intraperitoneal injection gave the same results. This entire work points to the clostridia, since they are accepted inhabitants of the intestine and are almost universal inhabitants of the liver (182). In addition, later work in Wangensteen's own department showed that all the liver effects were due to bacteria (55).

Rewbridge (135) drained bile into the peritoneal cavity and showed that death was infectious rather than chemical since the Clostridium welchii was always present, while there was no change in the serum bilirubin and bile salt values. Injection of sterile bile produced the same sequence of events, bacteria presumably entering the peritoneal cavity as a result of permeability changes induced by the bile. Large quantities of pure culture of the Clostridium welchii produced the same picture, although the amount necessary was reduced when bile was introduced simultaneously. This was further evidence of the importance of Welch organisms and the role of tissue as only a culture medium in the bile peritonitis and liver autolysis studies.

Bradley and Taylor (20, 21) showed that tissue autolysis varied with the *p*H, but bile did not accelerate the process. Jackson (90) considered factors influencing the rate of autolysis in the absence of bacteria.

Eisberg (56) correlated survival in segmental obstruction or isolated loops with the size and location of the segment, condition of its circulation, and bacterial content. The length of the segment was not as important as the circulation. Changes in the isolated, devitalized segments were thought to be responsible for the lethal outcome, but bacteria were not considered the major factor. The suggestion that later work might be able to clarify the role of the intestinal anaerobes was one step in the right direction.

In a study of histamine absorption from the obstructed bowel, Wangensteen (167) demonstrated a marked fall in the blood pressure when the vascular constriction due to a strangulated segment was released temporarily. Pressure rose when the constriction was reapplied, showing interference with absorption. Similar effects were not observed with the kidney or spleen. Rapid autolysis of intestinal mucosa was thought to liberate toxin, since it was the only tissue not present in the other organs. Blood pressure depression was attributed to bowel wall autolysis. It should be re-emphasized that strangulation obstruction creates ideal conditions for the growth of Welch organisms and that the release of constriction following mucosal damage might permit absorption of the Welch toxins, facts which could easily explain the observed pressure changes.

Wahren (164) showed that strangulation of a 20 centimeter loop in rabbits caused death in 24 hours, and that enclosing the loop in a rubber bag prolonged survival to 35 to 90 hours. The first group of rabbits was believed to have died of an intoxication before peritonitis could develop, but the second group developed peritonitis. The toxin could not be identified chemically. It was thought to come from tissue extract, but the bacterial factor was not excluded in this work.

Bunting and Jones (25) concluded that "reabsorption of a toxic secretion from the lumen of the duodenum is the important factor in causing the rapid death of rabbits after high intestinal obstruction." Unquestionably, electrolyte imbalance explained these results, but it is interesting that Bunting and Jones isolated the duodenal mucosa as the source of the toxin and excluded bacteria on the basis of their relatively low incidence in this part of the gastrointestinal tract. Bacteria do appear in this area following obstruction, and the anatomical arrangement of vessels in the duodenal wall allows distention to produce ischemia earlier than in other parts of the bowel. Thus Bunting and Jones unintentionally created a closed loop obstruction with all its attendant difficulties. In addition, Hartwell (79) pointed out that the period of food deprivation might be sufficient in itself to cause death of the rabbits, whereas the same period in a dog would have no effect.

Stone, Bernheim, and Whipple (156) showed that death quickly followed the production of an isolated, closed loop, but that drainage of the loop prolonged life indefinitely. The loop contents were toxic when injected into normal animals, producing shock and severe splanchnic congestion, the latter particularly in the small intestine. Similar toxic material was not obtained from autolysis, digestion, or putrefaction of the normal intestinal mucosa. Lethal effects were not attributed to bacterial multiplication, since Stone and his coworkers erroneously thought the majority of the organisms could be washed away. This was evidently the first time that the similarity of closed loop obstruction to other types of obstruction was mentioned. This group concluded (173) that "the material from the closed duodenal loops . . . can be formed in no other way than by the activity of the intestinal mucosa and the growth of the intestinal bacteria."

Analysis of the toxic agent was undertaken (174). Bacteria were not believed to be important. All toxic substances were thought to come from intestinal mucosa alone, and were not demonstrable in normal mucosa. Destruction of the mucosa, which was supposed to prevent the formation of toxin, was believed to be proof of the essential nature of mucosa in elaboration of the toxin. Experiments on which this statement was based seem open to considerable question. A closed loop was created after destruction of the mucosa with sodium fluoride. Since this loop fluid was not fatal when injected into other dogs, mucosal destruction was thought to render the fluid nonlethal. But loop fluid was subjected to incubation, autolysis, heat, centrifugation, and filtration before use, and thus the toxicity of the original fluid was not tested. The use of immunization against loop poison to prolong the life of dogs with a closed loop (175) suggested a bacterial origin of the poison. The theory of absorption of the toxin from the mucosa itself, rather than from the lumen, was supported by experiments in which the survival time was not adversely influenced by filling the loop with fluid from another dog (176). Since the absorption of noxious agents does not occur until the mucosa is damaged, this would not seem to prove the mucosal origin of the toxin. Further attempts to identify this toxin showed it to be a primary proteose (170, 171, 172). Whipple said (169) that there was a "definite proteose intoxication in intestinal obstruction and allied conditions, in general peritonitis, either septic or sterile, and in acute hemorrhagic pancreatitis," with the proteose intoxication as the major factor in symptomatology. At this time Whipple was disputing the claims of Hartwell and Hoguet (79, 80, 81) concerning the importance of fluid and salt replacement in the treatment of obstruction. The outcome of that disagreement is too well known to require further comment, and the absence of a toxin in simple obstruction has been adequately shown, although the place of a primary proteose toxin in strangulation obstruction has not yet been clarified.

Stone (155), attempting to correlate many divergent views, repudiated the opinions he had formerly expressed. He had shown that fresh secretions of normal intestine were nontoxic and remained nontoxic if kept under conditions that inhibited bacterial growth. But "this secretion when collected and kept free from external contamination, but incubated so its own bacterial count may grow, develops *in vitro* within 18 hours, toxic properties producing symptoms like those of fluids from closed intestinal loops. *These experiments render it unnecessary to assume the presence of mucosa itself in the production of toxic material.*" Regardless of the exact nature of the toxin, the effect of intravenous injection into normal animals was the same. Oral administration of toxin was without effect, demonstrating selective absorption of the normal mucosa. The subjects in dispute were the exact chemical nature of the

toxin, the precise mode of its absorption, and the "precise cause, bacterial or other, of the protein disintegration that results in toxin production." There was agreement on the effects of this toxin, that is, fall in the blood pressure, vomiting, diarrhea, temperature changes, rise in the blood nonprotein nitrogen, delayed blood coagulation time, profound congestion of the small intestinal mucosa, and collapse with death. The correlation of most of these ideas with our own should be noted—Welch exotoxin origin of the toxins replacing protein disintegration.

Knight and Slome (97) differentiated simple from strangulation obstruction and recognized various types of strangulation obstruction. They believed that toxemia existed, but the formation of a toxin "within the gut lumen has no significance whatever, if there is not positive evidence of its absorption." Current knowledge disproves their conclusion that death in simple obstruction was due to toxemia of protein degradation in the bowel lumen or wall. They disposed of the bacterial theory in strangulation obstruction in spite of the work of Murphy and Vincent (118) which they mentioned, and mainly on the basis of the work of McIver *et al.* (107). We cannot explain the complete discrepancy between the work of Knight and Slome and that of Holt on the fluid loss etiology of death in long loop strangulation (88). Medium loop strangulations were subdivided on the basis of viable or "pink loops" and nonviable or "black loops." In the black loop type the "peritoneal fluid was copious, markedly blood-stained, and possessed a characteristic odour," while the gut "lumen was in all cases distended with dark, haemorrhagic fluid." Peritoneal fluid toxicity of black loop experiments was demonstrated by intravenous injections and rubber bag experiments, but fluids from pink loops did not demonstrate any such effects even after periods of strangulation four times as long. The toxin was vasodepressor and caused arrhythmias. A depressor substance was found as early as 60 to 70 minutes after strangulation, and its appearance was correlated with the severity of the strangulation. Saline solution remaining for an hour or more in a closed and previously irrigated loop gave depressor effects. Saline solution from nonstrangulated loops showed no effect. Donaldson, Sive, and Lewis (49), in a somewhat similar work, showed that toxin developed in the presence of bacteria in a strangulated bowel in 2 to 4 hours. Knight and Slome claimed that the toxic agent came from the intestinal wall within 0.5 to 1 hour after strangulation and was present in the peritoneal fluid within an hour. Most of their work, however, was on peritoneal fluid from nonviable loops strangulated for more than 12 hours. They concluded: "While we do not dispute that bacterial invasion of devitalized tissue and subsequent proteolytic action may produce further toxic substances from the tissues of gut wall in the latter stages of strangulation where the viability of the gut is impaired, the early origin demonstrated for depressor substance, when the gut lumen was washed through and contained only saline, in our view definitely precludes a bacterial origin." The fallacy of a completely sterilized bowel has been noted repeatedly. In experiments with strangulation of only short duration, the lumen was still filled with bloody fluid, and in none of these experiments was the bacterial factor eliminated. Their results so closely parallel so many of our own results in which bacteria have been found in the peritoneal fluid that we believe that Knight and Slome have unjustifiably overlooked an important factor.

TISSUE AUTOLYSIS AND BACTERIA

Holt (2) agreed with Aird that a toxin with histaminelike qualities appeared rapidly following strangulation obstruction, and also could be obtained from other tissues subjected to anoxemia. The toxin which exuded from the strangulated loop in the later stages of strangulation obstruction had a different color and a foul odor. This toxin was produced only in the presence of bacteria "by lysis of protein in the bowel wall." Aird attributed death "to invasion of the devitalized bowel wall by bacteria, which pour into the peritoneal cavity the toxic products of their metabolism."

Gerard (67) identified the toxins as histamine and other putrefaction products formed in the lumen of the obstructed bowel by bacteria.

A number of workers who blamed toxicity on tissue autolysis seem to have forgotten that Wolbach and Saiki (182) described a "new" organism in 1909, present in normal, healthy, "sterile" liver. Correlation of the two theories led some workers to ascribe toxicity to products arising from tissue autolysis aided or induced by bacteria.

Andrews, Hrdina, and Rewbridge (7, 8, 9, 135, 136) noted the importance of bacteria,

TABLE I.—EFFECT OF SMALL BOWEL LOOPS WITH VARYING DEGREES OF STERILITY AND VARYING BLOOD SUPPLY

	Dragstedt, Moorhead, Burcky (53)	*Donaldson, Sive, and Lewis (49)*	*Murphy and Brooks (117)*
Isolated closed loops, duodenum, jejunum	Fatal		Fatal
Above, washed with water and ether	Some recoveries		
Isolated loop, open, blood supply good	No effect		
Above, then closure (loop sterile)	No effect		
Above, devascularized	No effect		
Fresh ileal secretions		No effect if bacterial count low	
Secretions taken 5 hrs. after closed loop created		Fatal	"Highly toxic."
Secretions from loops with blood supply occluded		Fatal	"Highly toxic."
Loop content mixed with antitoxin		Fatal	
Strangulated loop contents, filtered		Fatal	
Above with antitoxin		Fatal	
Isolated loop, blood supply disturbed			Earlier toxicity
Isolated loop contents, boiled			Highly toxic
Isolated loop contents, Berkfeld filtered			Less toxic
Isolated loop contents, autolyzed			Toxicity increased
Jejunal loop sterile, occluded			No effect
Jejunal loop sterile, occluded, reinfected			Symptoms

specifically the Clostridium welchii, in the final analysis of their work on autolyzing tissues.

The similarities between the work of Dragstedt, Moorhead, and Burcky (53), Donaldson, Sive, and Lewis (49), and Murphy and Brooks (117) make interesting comparisons, as shown in Table I. All accepted the presence of a toxin, but its methods of production and absorption were not known. Isolated, closed, duodenal, jejunal, or ileal loops were fatal, without apparent infection of the peritoneal cavity. Murphy and Brooks showed that symptoms did not appear without changes in the mucosa, and Dragstedt showed that some animals recovered if thorough washing of the loop with water and ether preceded closure. The 4-liter washing probably removed the majority of bacteria mechanically, and the ether may have temporarily depressed secretory activity sufficiently to prevent rupture of the loop by a too rapid accumulation of fluid. These two factors probably allowed the dog to recover. In the duodenum the secretory rate was so high and necrosis followed distention so rapidly because of the anatomical arrangement of the duodenal vessels that it was not possible to prevent distention and rupture. The onset of symptoms was greatly accelerated in all loops if their blood supply was disturbed.

Dragstedt, Moorhead, and Burcky (53), and Wangensteen and Waldron (168) each observed dogs whose loop had ruptured without producing peritonitis. Dragstedt's group found the loop to be sterile, and closure of this loop did not harm the dog, nor did severing the blood supply of an intraperitoneally draining, washed, isolated loop. Dragstedt and his co-workers concluded:

"An aseptic isolated closed loop of the upper jejunum is not incompatible with life. . . . [A]nemic necrosis of the intestine following occlusion of the blood supply produces no toxic symptoms when bacteria are excluded. . . . [T]he toxemia of intestinal obstruction cannot be due to circulatory changes in the intestine in the absence of bacteria. . . . Necrotic tissue plus the enclosed intestinal bacteria resulted in the formation of toxic products, which when liberated into the abdominal cavity and absorbed caused death. Whether the mere liberation of the contents of the loop without necrosis of the tissue would have caused death we do not know. However, from the fact that the liberation of the contents from a washed loop caused no symptoms, it would seem that this tissue necrosis is an important factor. [In the absence of anaerobic cultures, clostridia might have been missed.] . . . It is probable that bacteria alone or in connection with the contents of the lumen of the intestine, do not give rise to the toxemia of obstruction, when they are separated from the blood by the cells of the intestinal mucosa. However, a combination of these two factors (necrotic tissue plus putrefactive intestinal bacteria) rapidly gives rise to a fatal toxemia. It is probable that the death in experiments with the unwashed isolated intestinal loop is identical with that following gangrene of the intestine. The fatal toxins are the

result of the action of the putrefactive organisms on necrotic tissue. . . . We believe that the symptoms and pathology of these simple closed loops resemble cases of acute obstruction in man in which there is accompanying occlusion of the blood supply to a part of the intestine. . . ."

South and Hardt (152) confirmed most of the observations of Dragstedt, Moorhead, and Burcky.

Murphy and Brooks (117), and Dragstedt, Moorhead, and Burcky (53) arrived at these conclusions: (1) a sterile jejunal loop could withstand occlusion for longer periods than an infected one, but symptoms occurred if the sterile loop became reinfected; (2) closed intestinal loops without bacteria were not fatal; (3) closed loops with bacteria, but without tissue necrosis were not fatal; (4) closed aseptic intestinal loops with occluded blood supply were not fatal; (5) bacterial activity plus necrotic tissue, or the absorption of toxic products resulting from the action of putrefactive bacteria on necrotic tissue, was the important factor in the rapid death in simple, closed, intestinal loops; (6) death may occur without peritoneal infection; (7) toxin did not cross normal mucosa; (8) circulatory disturbance was essential for absorption to occur; (9) the earlier symptoms in obstruction of the duodenum were related to its greater secretion leading to its more rapid distention and circulatory disturbance.

Smith (151A) studied the bacterial flora of isolated, closed segments of bowel in dogs, life being maintained by repeated aspiration of the loop, which prevented overdistention with its usual sequelae. The most frequent findings were the Clostridium welchii (87.5%), the Escherichia coli (85%), streptococci, and staphylococci.

Donaldson, Sive, and Lewis (49) injected the contents of closed, isolated loops of ileum intraperitoneally into mice to test their toxicity. Nonsterile, fresh ileal secretion was nontoxic, provided the bacterial count was below 8 to 10 per oil field (the bacteria were almost exclusively the Clostridium welchii). Secretions taken 5 hours after creation of the loop, when the bacterial counts ranged between 30 and 200 per oil field, were fatal for mice. If the blood supply to the loop was occluded, the loop contents were uniformly fatal. Murphy and Brooks had also shown that a strangulated loop contained highly toxic material at a time when loops with a normal blood supply contained little or no material. Donaldson's finding that loop contents which were in contact with an equal volume of antitoxin failed to give protection does not appear to be significant since the volume of loop contents is no indication of its toxin content. Berkfield filtration did not prevent lethal results in mice. Murphy and Brooks showed that filtration and boiling decreased toxicity, but did not exclude it. Our own work has shown that filtration does not remove toxicity from Welch cultures (34). Murphy and Brooks further showed that the fiuid from a segment of dog intestine filled with blood or saline solution and allowed to autolyze in an incubator produced toxic symptoms and a pathologic picture similar to those of occluded intestinal loops. Their conclusions were (1) that the contents of obstructed bowel were toxic if given in sufficient quantity; (2) that the toxins were the result of bacterial growth; (3) that the character of the toxin varied with the duration and type of obstruction; and (4) that the toxins which were produced most rapidly were the result of the proteolytic action of bacteria on damaged intestinal wall structures.

Dvorak (55), and Ellis and Dragstedt (57) worked along similar lines, as is shown in Table II. Dvorak concluded, "Anaerobic bacteria or their toxic products cause death in autolysis of dog's liver *in vivo*. . . . No toxic product was found in the liver responsible for death which was inherent to liver tissue and independent of bacterial activity." Because of the many similarities these results should be considered in strangulation also. From cultures of fresh liver, Ellis and Dragstedt concluded that "the uncontaminated liver of normal living dogs regularly contains anaerobic bacteria. . . . It seems probable that this organism forms exceedingly poisonous substances when permitted to grow in dead liver, and that it is the absorption of these poisons from the peritoneal cavity that causes death. . . ."

Using similar techniques with liver and muscle, Harkins, Harmon, and Hudson (75A) concluded that death might result from plasma loss due to local irritation, absorption of toxic products produced by damage to the local tissues, absorption of toxic products from foreign bodies inserted, increased general vascular permeability secondary to some absorbed products, or absorption of exotoxins produced by the organisms.

More recently, Reissmann and collaborators (133A) have established the importance of bacteria in intraperitoneal liver autolysis by a novel

approach to the problem. Donor dogs were saturated with antibiotics preoperatively so that the liver tissue placed in recipient dogs was already under antibiotic control. Recipient dogs were also given antibiotics. Under these conditions, recipient dogs showed no ill effects, demonstrating the inability of sterile liver to produce a fatal result by intraperitoneal autolysis.

Fine's study of "shock liver" (58A) demonstrated the presence of some lethal agent not present in normal livers. The lethal agent was attributed to bacterial activity since pretreatment with antibiotics eliminated the lethal effects.

Bacterial contamination of liver in normal healthy dogs was shown by Wolbach and Saiki (182) to be almost universal. The contaminant has since been commonly accepted as the Clostridium. Ellis and Dragstedt (57) quote others who found normal tissues containing bacteria: Magnus-Levy, Ford, Conradi, Bierotte and Machida, and Amako. Reith (134) investigated the bacterial content of tissues of apparently normal, healthy, live animals. Positive cultures were obtained in 77 to 83 per cent of the muscular tissues of hogs, rabbits, and guinea pigs under aerobic conditions and in 37 to 49 per cent under anaerobic conditions. Thus, many workers who attributed fatal results to autolysis of sterile tissues were working with contaminated tissues, and their results must be reinterpreted in the light of this knowledge.

Trusler and Reeves (161) found anaerobic gram-positive rods in the liver and muscle of healthy dogs, but believed these differed from the true Clostridium welchii. The known variations within single strains of anaerobes may have played some role in this finding. Their admission that "we do not insist that at all times we have been working with absolutely pure . . . cultures" should create some doubt concerning their observations. The intraperitoneal injection of 35 cubic centimeters of whole culture was not lethal to the dog, while the same quantity of Welch culture was. However, our own experience (34) shows that this dose may not be lethal under all conditions, and many additional experiments would be needed to confirm this difference in pathogenicity. It would seem unwise to conclude that the second organism was nonpathogenic on the basis of toxin or bacterial count. It is regrettable that Trusler and Reeves did not further identify their organisms or purify their cultures. They continued to insist that the organism found in the liver was not the Clostridium welchii (108B, 160A, 161A), although certainly the overwhelming evidence from other sources would indicate that it was. They confirmed the lack of toxicity of intraperitoneally placed, autoclaved, fresh liver and the rapidly lethal effect of nonautoclaved liver. In spite of these conclusions, they did not believe bacteria invaded the peritoneal cavity following the introduction of irritating substances.

Much of this difficulty may be resolved by a recent study which showed the contamination of normal viscera from healthy animals (144). In dogs, 90 per cent of the livers examined contained bacteria, and more than 80 per cent infection was found in the lung, pancreas, and spleen. "It appears that all organs of the healthy dog, not only liver and pancreas, are more or less regularly contaminated with clostridia." Toxin production, though weak, was demonstrated. This weak toxin may explain the failure of other workers to achieve lethal results.

Markowitz, Rappaport, and Scott (108A), in their work on the protection of animals with penicillin following ligature of the hepatic artery, have further emphasized the role of bacteria. Untreated dogs showed massive total necrosis of the liver. "Overwhelming numbers of bacteria, nearly all spore-bearing bacilli, were everywhere present in the necrotic tissue, its blood vessels and bile ducts." They concluded: "Our experiments, using penicillin, settle a current controversy in favor of Dragstedt and his school, who maintain that the liver normally houses an obligatory anaerobe which proliferates and fills the liver when arterial blood is no longer offered to the organ."

Dragstedt, Haymond, and Ellis (52), in a review of pancreatitis, were forced to return to in vivo and in vitro tissue autolysis studies, and their report is of interest here because of its close correlation with these studies:

"The experimental evidence . . . make[s] it appear most probable that the toxemia of acute pancreatic necrosis is due to the absorption of toxic substances produced in the necrotic pancreas by the action of bacteria. Bacteria are present in the uncontaminated pancreas of a high percentage of normal rabbits and dogs. . . . [U]nder normal conditions, they [the bacteria] evoke no signs of inflammation in the pancreas. . . . [A]ll cultures taken from the necrosing pancreatic tissue of the dogs that died from autolysis of

TABLE II.—EFFECT OF VARIOUS AGENTS ON INTRAPERITONEALLY PLACED LIVER OR PANCREAS

	Ellis and Dragstedt (*57*)	*Dvorak* (*55*)	*Dragstedt, Haymond, and Ellis* (*52*)
Ligate lobe of liver in situ	Lethal		
Culture of this liver	Anaerobic gram-positive rod		
Liver in peritoneum, normal dog	Lethal		
Culture fresh liver	Positive		
Autoclaved liver in peritoneum	No effect	No effect	
Autoclaved liver, plus pure culture of organisms from fresh liver	Lethal	Lethal	
Liver heated to destroy enzymes, not bacteria	Lethal	No effect	
Fetal liver, sterile	No effect	No effect	
Ground adult liver		Lethal	
Liver boiled, then incubated		Lethal	
Pure cultures, large quantities		Lethal	
Aqueous extract of ground liver		No effect	
Above, with incubation		Lethal	
Above, with boiling		No effect	
Fetal liver incubated		No effect	
Autoclaved liver plus filtrate fresh liver		Fatal	
Autoclaved pancreas			No effect
Fetal pancreas			No effect
Ground autoclaved pancreas plus sterile active pancreatic juice			No effect

the pancreas yielded an organism very similar to, if not identical with, B. welchii. . . . The product secured from the digestion of pancreas by pancreatic juice in the absence of bacteria was found to be practically nontoxic on intraperitoneal injection. The innocuous effect of implanting autoclaved pancreas or fetal pancreas, proved to be sterile by culture, into the peritoneal cavity is in harmony with this finding. The implantation of a mixture of ground autoclaved pancreas and active pancreatic juice, proved to be sterile by culture, into the peritoneal cavity without the production of toxemia represents almost a crucial experiment. It proves that neither active pancreatic juice nor the products arising from the digestion of dead pancreas by pancreatic juice within the abdomen are sufficiently toxic when the bacteria commonly found in the intact pancreas have first been removed. The conclusion seems inescapable that in some way these bacteria are necessary for the development of a toxemia in pancreatic necrosis. . . . The frequent findings of B. welchii in the necrotic pancreas suggest that its specific toxin may play a role in the disease."

Thus, in another field, Dragstedt again emphasized the importance of Welch organisms in the production of toxemia, provided necrotic tissue was present.

BOWEL CONTENT AND PERITONEAL FLUID TOXICITY

There is an interesting series of studies on the toxicity of the bowel contents and peritoneal fluid in obstruction. These are difficult to classify on the same basis as the other articles, but some of the salient features which are closely allied to the present problem will be discussed. Other work which deals with loop or peritoneal fluid (43, 49, 50, 75, 88, 97, 107, 117, 118, 127, 128, 142, 148, 155, 156, 160, 174, 175) is discussed elsewhere in the paper.

Braeye (22) injected intravenously into small dogs the fluid from isolated, closed, high, small intestinal loops. Loop fluid was nontoxic up to 36 hours, after which it became quite toxic, being fatal within 5 to 15 minutes after injection. There was no distinct correlation between toxicity of the fluid and gangrene of the loop. Symptoms following injection included shock, vomiting, defecation, paresis of the hind legs, and dyspnea. Autopsy findings included intense congestion of the peritoneum and viscera, and severe submucosal hemorrhages in the duodenum—this latter taken to be typical of the reaction to the "toxin." Since survival was considered to be a negative result, even though the animal had a severe reaction immediately following the injection, the nontoxicity of loop fluid prior to 36 hours is open to question. Furthermore, some of these severe reactions were observed with injections of only 25 cubic centimeters, and no attempt was made to note the effects with greater volume.

Later work (23) demonstrated that this toxin would not permeate a normal, viable, intestinal wall.

Wangensteen and Chunn (166) injected intestinal contents from dogs and rabbits intravenously into dogs and intraperitoneally into rats to study toxicity. All intestinal contents were found to be toxic whether from normal or obstructed animals. The fluid below the site of obstruction was slightly more toxic than that above the obstruction. Gatch, Trusler, and Lyons (66) observed a greater effect on the blood pressure following intravenous injection of contents of normal intestine than following intravenous injection of contents of obstructed intestine. Duodenal contents containing pancreatic secretions were extremely toxic. Most of the effects noted with normal intestinal contents were probably due to the pancreatic portion, since the source of obstructed contents was isolated loops which excluded pancreatic secretions. If pancreatic secretions were included in the loop contents, the toxicity was increased. Van Buren (162) also found normal intestinal contents toxic. Hibbard and Kremen (85) concluded that the volatile bases in intestinal contents following obstruction could be responsible for some of the toxic effects. None of these workers used contents from strangulated loops, and we now know that death in simple obstruction is not related to absorption of any products formed in the gastrointestinal tract.

Sweet, Peet, and Hendrix (156B) summarized much of the data regarding the role of pancreatic secretions in intestinal obstruction. The importance of the "lethal line of Draper" was noted, but it was not correlated with the acid-base imbalance resulting from the loss of pancreatic secretions. A closed loop low in the ileum was not necessarily fatal, but it became so if the loop was filled with either pancreatic juice or pancreatic tissue. This was assumed to be further evidence of the role of toxicity of pancreatic secretions. However, the destruction of the distended bowel and its permeation may have been accelerated by the proteolytic pancreatic secretions and the bacterial growth in the ideal culture medium of the pancreas or its secretions. Ligation of pancreatic ducts in duodenal obstruction prolonged survival over that in animals without division of the pancreatic ducts. This would seem to demonstrate the importance of pancreatic secretions in acid-base balance rather than any possible production of toxins by the pancreas. In addition, these workers were interested only in simple obstruction.

That bile, or pancreatic or duodenal secretions are significant only in so far as their electrolyte role is concerned in simple obstruction has been demonstrated by Benedict, Stewart, and Cutner (13), by Johnston, Clasen, and Orr (95), by Jenkins (91, 92, 93, 94), by Pearse (130), and by White and Fender (177).

Hill and Stoner (87) injected intravenously into normal dogs the contents of obstructed bowel loops, normal intestinal contents, incarcerated bowel contents, and incarcerated, strangulated bowel contents. They observed a more consistent correlation between toxicity and leucopenia than between toxicity and objective findings. The contents of normal intestines and of obstructed intestines were toxic. The transudate from the obstructed loop produced neither objective effects nor blood count changes. Leucopenia followed the injection of the transudate around a strangulated loop or intraperitoneal injection of the contents of a strangulated loop (86).

Maycock (112) studied the peritoneal fluid from cats with strangulation obstruction. A toxic effect could not be demonstrated uniformly by intraperitoneal injection of fluid obtained from such animals. This result should be contrasted with the work of Knight and Slome (97) as well as with that of Nemir *et al.* (120). Some of the discrepancy was undoubtedly related to the small quantity of fluid injected, and also to the failure to separate the fluid obtained in the early hours of the strangulation from that obtained later when greater toxicity was present.

Heuer and Andrus (84) discussed the supportive effects of adrenocortical extract in animals receiving otherwise fatal doses of strangulation loop fluid. The preparation of the loop fluid might be open to question, but it did not involve complete destruction of any bacterial products. The use of the intravenous route for injection can be condoned on the basis of the large doses otherwise needed, since dogs were the test animals. The fluid loss, in the form of pure plasma or a plasma filtrate, causes a plasma volume decrease of 20 to 40 per cent. A general loss of capillary tone and an increased capillary permeability were thought to exist, since autopsy showed fluid in the intestinal tract and severe congestion of the liver and viscera. The "shock" state was not corrected by large volumes of electrolytes, colloids, plasma, blood, or adrenalin, but adrenocortical extract plus transfusions did prolong life. The correlations between this

and Welch toxin effects are apparent and, since no attempt to remove bacteria or bacterial exotoxins was made, we cannot ignore their importance.

Laufman and Freed (99) utilized the Menkin reaction to study the effect on capillary permeability of the peritoneal exudate in strangulation obstruction. Capillary permeability was increased but adrenocortical extract prevented the local changes in capillary permeability. Fluid injected intraperitoneally in mice killed 86 per cent in 24 hours, while fluid plus adrenocortical extract caused only a 48 per cent mortality. Seitz filtration decreased the toxic effect. Some of the toxicity in strangulation obstruction was ascribed to some factor which produced shock by increased capillary permeability and which responded, at least partially, to adrenocortical extract.

RECENT WORK

Re-evaluation of experimental strangulation obstruction on the basis of our current knowledge regarding fluid and electrolyte balance, hemorrhage, shock, dehydration, and better anesthesia was undertaken by Nemir, Hawthorne, Cohn, and Drabkin (119), since the cause of death had not been found even with experiments utilizing antibiotics. They utilized a standard type of strangulation obstruction in dogs, which involved obstructing the bowel by dividing it and closing the two ends, and then ligating all veins to a 30 centimeter segment of the obstructed bowel. Derr and Noer (48) had emphasized the importance of using a segment longer than 15 centimeters and Scott and Wangensteen (147, 149, 165) had shown that ligating the veins gave a shorter survival than ligating arteries or arteries and veins combined. Frequent bacteriologic, chemical, and spectrophotometric studies of the peritoneal fluid, bowel contents, and blood were made. Postoperative survival ranged from 28.25 to 48 hours, with an average of 36 hours. This was longer than the survivals of only 7 to 24 hours of previous workers. On recovery from anesthesia the animals remained in good condition until 1 to 4 hours prior to death, when they suddenly became much sicker, began vomiting more severely, and began having respiratory difficulties. Concurrent with this change in their clinical condition were several important changes in the chemical and spectrophotometric findings in the various fluids. The peritoneal fluid of the early postoperative period was reddish, coagulable, and odorless, but not hemolyzed. When the clinical condition changed, this fluid became black, foul-smelling, noncoagulable, and severely hemolyzed. Both grossly and spectrophotometrically this late peritoneal fluid resembled the fluid obtained from the strangulated segment shortly after strangulation. The nitrogenous components of the bowel contents, peritoneal fluid, and blood stream were all elevated at this time. Cultures of the peritoneal fluid were frequently sterile 14 to 20 hours following the operation. After this, the organisms previously cultured from the bowel lumen began to appear in the peritoneal cavity. Bacteremia was not thought to be of significance in any experiment. Spectrophotometric examination showed a new hemoglobin derivative in the bowel content shortly after strangulation. When the peritoneal fluid became blackish the same hemoglobin derivative was detected there in a lesser concentration. Following this, the new pigment was observed in the blood stream. The sequence of chemical and spectrophotometric events identified the route of absorption of the pigment, the nitrogenous components, and any toxic products as follows: bowel lumen—across the bowel wall—peritoneal fluid—blood stream. These studies showed that even adequate electrolyte control and blood and plasma support would not indefinitely prolong life in dogs with strangulation obstruction.

The close correlation between death of the animal and appearance of the black peritoneal fluid suggested the presence of some lethal factor in the black fluid. This was evaluated by injecting the peritoneal fluid intraperitoneally or intravenously into normal dogs (120). The early red peritoneal fluid was without effect. The late or dark peritoneal fluid was lethal in almost every experiment. Toxicity was correlated to a certain extent with the concentration of pigment found spectrophotometrically. The toxic agent could not be identified with the altered pigment, but some lethal toxic agent was present in this later peritoneal fluid which was capable of producing an autopsy picture similar to that of animals dying from strangulation obstruction.

Clinical confirmation of the experimental findings was attempted in a study of all cases of strangulation obstruction submitted to surgery in seven large Philadelphia hospitals over a 2 year period (29). The peritoneal fluid from these cases

was subjected to spectrophotometric and bacteriologic analyses. Of the 18 cases available for study, 11 were not examples of strangulation obstruction, and there was no change in the spectrophotometric observations in any of these. In 3 cases, strangulation was said to be present, but was not thought to require resection, and none of these cases had any spectrophotometric abnormalities of the peritoneal fluid. In 4 cases, resection was undertaken for strangulation. Only 1 of these (the only case in the entire series) showed any abnormality of the spectrophotometric curve (39). This one had changes similar to those observed experimentally. Positive bacteriologic findings were more common in cases of strangulation obstruction than in cases without strangulation. Positive peritoneal fluid cultures were associated with more postoperative complications than were negative bacteriologic findings, regardless of whether or not strangulation was present. The infrequent clinical occurrence of positive changes in the spectrophotometric analyses of peritoneal fluid served to deemphasize the importance of this as a clinical finding, even though it had been observed a single time. There was better correlation with positive bacteriologic results in the peritoneal fluid.

Nemir, Hawthorne, and Drabkin (121) attempted to reproduce the abnormal hemin pigment in vitro by mixing blood with the various substances found in the strangulated obstructed loop. The various mixtures were incubated under conditions that would permit bacterial growth. An abnormal spectrophotometric curve somewhat similar to that observed in strangulation obstruction was obtained by the in vitro mixture of blood and activated pancreatic juice. The pigment was identified as a hemin split from the globin of hemoglobin. The substance containing this abnormal absorption spectrum was also shown to have a rapidly lethal effect when given in small intravenous doses. However, activated pancreatic juice mixed with plasma alone also produced a highly lethal substance, without producing an abnormal spectrophotometric curve. This showed that the toxic element could be obtained in the absence of the pigment-producing substance. Bile or pancreatic juice can be obtained and maintained sterile only rarely, and the authors of this article admitted that they "were unable to secure sterile activated pancreatic juice. Invariably one or more of the usual bacterial flora, *E. coli*, *Clostridium welchii* and/or *Strep. hemolyticus* were present, and following incubation for 36 hours, all injected substances cultured had positive cultures." The authors were unable to produce the abnormal spectrophotometric curve by the incubation of blood with Seitz-filtered, activated pancreatic juice, but if the three bacterial strains were added to this combination the abnormal spectrophotometric curve was obtained. Thus the bacterial factor was not eliminated. Incubation under conditions suitable for bacterial growth (particularly for Clostridium welchii) did not eliminate bacterial effects or bacterial toxins. Injection of the incubated mixture would permit a toxin to act almost immediately.

The same group made further attempts to clarify the role of bacteria (122). The inability to obtain sterile, enzymatically active pancreatic juice led them to inject mixtures with known bacterial content and spectrophotometric curves. They concluded, "Bacterial contamination qualitatively and quantitatively cannot be correlated with survival of animals receiving intravenous injections of the various combinations of substances used in these experiments. No information concerning the role of bacterial exotoxins was afforded by these experiments." However, in 3 instances, the injected fluid was not lethal even though the characteristic absorption spectrum was found. Thus, there was incomplete correlation with either the bacterial content or the spectrophotometric findings in the fluid. The ideal conditions for the growth of anaerobic bacteria provided by incubation were not obviated.

Further evaluation of the role of pancreatic juice and other duodenal contents in the production of the toxic material was obtained by Cohn, Gelb, Hawthorne, and Drabkin (37). They devised a method of studying strangulation obstruction after diversion of all duodenal contents to prevent the interaction of duodenal secretions with the contents of the obstructed bowel. This was achieved by the use of a modified Mann-Williamson operation with diversion of the duodenal contents to the lower small bowel. At a later period a strangulation obstruction was established above the re-entrance of the duodenal secretions. Strangulation obstruction in the complete absence of pancreatic, biliary, and duodenal secretions did not prevent death of the experimental animal. Spectrophotometric observations similar to those previously reported were

found in 1 animal, indicating that pancreatic juice was not essential for its formation. The slightly longer survival of these animals, as compared with strangulation obstruction in the normal intestine, was believed to be due at least partially to the absence of the proteolytic effects of the pancreatic enzymes. Thus, the essential role of pancreatic juice in the toxicity of strangulation obstruction was excluded.

Cross (41A, 41B) utilized a pressure chamber to demonstrate that increased pressure and a higher concentration of oxygen increased survival of closed loops of bowel by decreasing the distention and aiding the absorption of the contained gases.

A resurgence of interest in the importance of the Clostridium welchii in intestinal obstruction has been evident recently. Anderson and Tanturi (157) were able to show that lecithinase, the lethal factor of the alpha toxin of Clostridium welchii, was present in the appendical fluids of 89 per cent of dogs with experimental appendicitis. This enzyme produced a severe toxemia following its absorption. While no one factor could explain death from experimental peritonitis, the lethal toxin of Clostridium welchii was held primarily responsible for many of the alterations in hemodynamics and hepatic function. Lecithinase was demonstrated in the lumen of the obstructed, strangulated small intestine in 91 per cent of the dogs studied. The toxin was also identified in the abdominal exudate in one-third of the animals prior to gross perforation of the obstructed segment. Lecithinase was first detected in the strangulated bowel 5 hours after strangulation. Serum from animals which recovered from some intra-abdominal gangrenous process offered better protection to other animals than did the commercially available Welch antitoxin. Since a true bacterial peritonitis is rarely found in experimental intestinal obstruction, it was suggested that absorption of the toxins was fatal before peritonitis could develop. Thus, the lecithinase toxin of Clostridium welchii was considered one of the significant factors in the death of dogs with strangulation intestinal obstruction (6). The many possible correlations between this work and the toxicity of the peritoneal fluid demonstrated by Nemir, Hawthorne, Cohn, and Drabkin (120) should be apparent. Hyaluronidase, not present in the normal contents, was found in significant quantities in the intraluminal contents of strangulated intestine in 83 per cent of the dogs studied. It could not be found in the abdominal fluid in experimental strangulation obstruction. The importance of this enzyme, produced by Welch organisms and other bacteria, in increasing bowel-wall permeability and freeing intraluminal contents into the peritoneal fluid was pointed out (158).

Laufman and his associates were unable to detect lecithinase in the peripheral blood or the portal blood of animals with experimental strangulation obstruction (101, 102). However, it was also shown that enormous quantities of lecithinase could be present in the blood stream and yet be undetectable (61). Binding of lecithinase by the red blood cells was believed to render it unavailable for chemical detection. Cannulization of the thoracic duct revealed lecithinase in significant quantities 5 hours after strangulation, proving it was absorbed. Some of the difficulties of earlier workers in detecting toxin and in correlating the effects of the Clostridium welchii and strangulation obstruction might thus be explained, since bacteria need not be present in the blood stream (61).

Cohn and Hawthorne (38) evaluated the role of Clostridium welchii in strangulation obstruction by utilizing closed segments of small bowel which were separated from all vascular, lymphatic, and neurogenic connections and then placed free in the peritoneal cavity of normal dogs. Similarities to strangulation obstruction were demonstrated by chemical, bacteriologic, and clinical studies. This technique eliminated obstruction with its consequent vomiting and electrolyte imbalance; hemorrhage into the obstructed, strangulated loop; lymphatic absorption from the obstructed loop; and the interaction of blood, bacteria, and gastrointestinal secretions in the strangulated loop. Similar loops of bowel, sterilized by autoclaving, were placed in the peritoneal cavity. Intraperitoneal autolysis of sterile bowel was harmless to the dog. Sublethal doses of Clostridium welchii combined with isolated, autoclaved sterile, nonviable bowel in the peritoneal cavity of normal dogs was fatal. Since autoclaving might have altered some salient feature, bowel was sterilized by prolonged contact of an open, intact loop with the peritoneal cavity. This loop, combined with sublethal doses of Clostridium welchii in the peritoneal cavity of normal dogs, was lethal also. Thus, while neither sterile bowel nor small doses of Clostridium welchii were lethal in the peritoneal cavity, the combination

produced a rapidly fatal result which resembled that of strangulation obstruction (38).

Laufman and his associates (100) also observed that the intraperitoneal autolysis of sterile, devascularized intestine was without effect. By a series of graded operations, they demonstrated that the intraperitoneal autolysis of a segment of bowel in the absence of bacteria was totally without effect.

Introduction of the antibiotic agents opened up new avenues of approach to the bacterial factors in strangulation obstruction and served as a stimulus to reviewing the problem. Harper and Blain studied the effect of penicillin in closed loops to evaluate the importance of bacteria in intestinal obstruction (77). Death occurred in all control animals within 6.5 days. All dogs survived for 9 days when penicillin was placed in the isolated, closed loop. Sixty per cent of this group survived for more than a month. Parenteral penicillin permitted survival of all dogs for 18 days, with 1 living 60 days. The Escherichia coli, Clostridium welchii, streptococci, and staphylococci were the organisms most commonly found at the first operation. At autopsy these organisms were present in the loop, peritoneal fluid, and heart blood of the majority of control dogs. In the penicillin group, the loop contents were sterile as long as penicillin was detectable there, even though smears showed the presence of bacteria. When penicillin could no longer be detected in the loop contents, the organisms present at the first operation began to grow out. By the end of 30 days, loop cultures gave a profuse growth of these same organisms, even though the animal was asymptomatic. The authors concluded that marked distention of the loop in the presence of bacteriostatic agents was compatible with life; that, in the absence of distention, the uninhibited bacterial flora was compatible with life; and that distention must precede infection of the intestinal wall by the normal intestinal flora. Penicillin, used either intraluminally or parenterally, could prevent infection of the distended intestinal wall by normal intestinal flora. Once again Harper and Blain came to the conclusion reached by many previous workers that "bacteria or their products in the presence of distention are responsible for the 'toxemia' and death in dogs with isolated obstructed intestinal loops." In spite of the objections to the use of the closed loop, their article was significant because it showed the importance of bacteria or their products as the cause of death in isolated obstructed loops.

Blain *et al.* (16, 17, 18, 96) utilized penicillin postoperatively in strangulation obstruction of the small bowel. Controls survived 16 to 35 hours, but of the dogs treated with massive doses of penicillin, 90 per cent survived 50 hours or more, and the majority survived resection of the strangulated segment for 72 hours. Clinical and postmortem observations were similar to those reported by Nemir, Hawthorne, Cohn, and Drabkin (119). At autopsy or reoperation in the penicillin-treated animals, the strangulated bowel was thick and firm, in contrast to the large areas of friable, tissue-paper thin, necrotic bowel wall in the control animals. Histologic sections of the strangulated segment of penicillin-treated dogs showed less infection than did segments from the control series. Cultures of the bowel lumen showed the Escherichia coli, Streptococcus fecalis, Staphylococcus aureus, and Clostridium welchii most frequently. These same organisms were found in the intestinal tract at death, even in the treated dogs. Peritoneal fluid cultures were frequently negative during the first 24 hours unless perforation had occurred. Thus life was prolonged for a significant but limited period by massive doses of antibiotics. Penicillin was thought to prevent toxemia by delaying or completely inhibiting invasion of the bowel wall. Many observers were still skeptical about the importance of bacteria in strangulation obstruction because the animals were not allowed to survive longer and because gross and microscopic observation of the resected strangulated segment showed evidence of severe damage. These studies demonstrated the important role of bacteria in the toxemia and death in dogs with strangulation obstruction, but the authors emphasized that "further studies in which a more perfect sterilization of the bowel is established . . . will be necessary in order to evaluate the relative importance of [this] factor."

Harper and Lemmer (78) observed that the incidence and degree of hemorrhage, necrosis, and ulceration of the intestinal wall in simple obstruction increased as the level of obstruction progressed down the intestinal tract. Normal intestinal bacteria, whose growth had been stimulated by the more nearly ideal conditions of obstruction, acting upon tissue whose resistance had been lowered by the ischemia of distention, were blamed for this. The lower concentration

of activated pancreatic juice in the lower intestinal tract seemed to exclude pancreatic juice as a factor in these changes in the intestinal wall.

Shortly after the introduction of the various antibacterial agents, the possibility of producing a sterile gastrointestinal lumen was suggested by various workers in connection with surgery of the large bowel. It was inevitable that such a procedure would be used in the study of intestinal obstruction. Sarnoff and Poth (140) were quick to utilize succinylsulfathiazole to protect the ileum of dogs with venous strangulation of 50 centimeter segments. These animals were not obstructed. Control dogs with this venous obstruction survived for less than 48 hours; 5 of the 7 animals with 10 days of preoperative preparation with oral succinylsulfathiazole survived. At autopsy, the control animals had a bloody, purulent peritonitis and gross perforations of the involved segment. In 2 treated animals that died, perforations were not present, although a bloody, purulent peritonitis was observed. There were areas with only the serosa intact. The involved segment was purplish-black and did not appear viable. Three sources of collateral venous drainage in the surviving animals were (1) the omentum, (2) the avascular portion of the mesentery, and (3) adhesions to the normal bowel. This strangulated segment of bowel was indistinguishable from the normal ileum. Microscopically there was some fibrosis in the muscularis. At 50 days even these changes had disappeared, and the bowel segments were indistinguishable from the normal ileum.

Sarnoff and Fine (139) evaluated sulfonamides by the oral, local, and intravenous routes in strangulation alone and in strangulation obstruction. Maximum protective effect was obtained when the sulfonamide was given well in advance of vascular injury, but sulfonamides administered at the time of, or following, vascular injury were also beneficial.

Poth and McClure (131) studied the effect of sulfathalidine and sulfasuxidine on strangulation of the terminal ileum of dogs by arterial and combined arterial and venous strangulation. They concluded that "the bacterial flora is an important factor in bowel necrosis in intestinal obstruction." Segal, Schweinburg, and Fine (151) showed that sulfonamides also decreased the amount of gas formation in the obstructed bowel.

Laufman (98) studied the effects of penicillin in dogs with a segment of ileum subjected to venous strangulation for 6 hours. The survival of all treated animals in contrast to the death of all controls showed that massive doses of penicillin would help to preserve viability in segments of bowel in which the venous blood supply was temporarily occluded.

Davis and his associates (44) studied the effects of parenterally administered streptomycin on intestinal strangulation in rabbits. All of the controls died, but all animals receiving streptomycin survived for 2 months or more. Since the action of streptomycin depended upon its being carried to the strangulated area by the blood stream, the extent of the area of strangulation determined to a certain degree the prevention of bacterial gangrene and perforation of the bowel wall by the antibiotic activity.

Rabinovici and Fine's (132, 133) excellent appraisal of the effect of aureomycin on the intestine subjected to vascular injury should be studied carefully. They compared venous ligation, arterial ligation, and combined arterial and venous ligation in dogs which had (1) no antibiotic therapy, (2) aureomycin prior to vascular injury, (3) oral administration of aureomycin after vascular injury, (4) intraluminal administration of aureomycin, or (5) intravenous administration of aureomycin after vascular injury. The survival rate of the untreated animals was 20 to 30 per cent. In contrast to this, the aureomycin group had survival rates of 30 to 100 per cent, depending upon the route and time of antibiotic administration. One hundred per cent survival was obtained in the animals given aureomycin orally after venous ligation. Aureomycin given orally immediately after injury was as good as if given in advance. Eighty per cent of the animals with venous ligation alone survived if only 100 milligrams of aureomycin were placed in the bowel lumen at surgery, a fact which demonstrates both the rapidity of the antibacterial activity and the value of intraluminal administration of a drug in the interval immediately following injury. The relatively poor survival rate with aureomycin given intravenously was attributed to the lower intraluminal drug concentration and the toxicity of the drug when given by the intravenous route. The relatively poor results in combined arterial and venous damage indicated that the degree of vascular damage was so great as to preclude survival even with adequate antibiotic therapy. Blood loss played an insignificant role in the death of these animals. In

the antibiotic-treated animals there was almost no blood lost in the peritoneal cavity, and the loss in the wall and lumen of the bowel was significantly less than in the wall and lumen of the bowel of animals not treated with antibiotics. This demonstrated that much of the fluid loss in the untreated animals was caused by bacterial action.

After venous occlusion the loop became congested and cyanotic, with numerous petechiae in the mesentery distal to the division of the main venous trunk. Twelve to 18 hours after injury an untreated loop was flaccid, black, and penetrated with blood in all layers. The mesentery was heavily congested and covered with fibrinous exudate. Hemorrhagic peritoneal fluid was present. After a similar interval in a treated animal the loop was dark red and other changes were less pronounced than those just described. In the untreated loop, arteries and veins distal to the ligature contained a firm clot completely occluding the vessel, whereas in the treated loop clots were present, but liquid blood could be squeezed out. In both treated and untreated animals omentum was attached to the injured loop after 6 hours. Within 24 hours the omentum completely enveloped the injured loop with its attachment limited exactly to the borders of the injured loop. If the dog succumbed, the loop was black and necrotic, the lumen was filled with blood, and the mucosa was ulcerated, edematous, or sloughed off. Veins distal to the division were distended and thrombosed. The corresponding mesentery was hemorrhagic and a hemorrhagic peritoneal exudate was present. In the surviving animals, the intensity of the reaction was noticeably declining at 24 hours. Peritoneal hemorrhagic exudate was decreased or completely absent. Edema and congestion of the loop were reduced. In the animals which recovered, certain differences were still detectable in the loop 10 weeks following the injury, the wall being thicker than normal and the diameter being smaller. Following arterial occlusion the loop became white immediately and after 20 to 30 minutes changed to a pale bluish-white. There was little hemorrhagic exudate in the peritoneal cavity, the loop being necrotic and glued to the neighboring loops. The immediate effects of combined arterial and venous occlusion were similar to those of arterial occlusion, except that the initial pallor was replaced by cyanosis and later by a marbleized appearance due to alternating areas of ischemia and stagnation. At autopsy the loop was black and necrotic; the mesentery congested, swollen, and covered with fibrin; and the vessels were engorged with thrombi. Hemorrhagic exudate was abundant in the peritoneal cavity and in the lumen and walls of the loop.

Revascularization of the injured bowel, studied by radiopaque dye, came from five areas: (1) new small vessels running the full length of the mesentery, (2) arcades bridging the divided vessels and restoring continuity, (3) mesenteric vessels of the adjacent loops, (4) adhesions to the serosa of healthy loops, and (5) the omentum. The omentum seemed to be a critical source of blood supply in the important period immediately following injury. Peritonitis studies indicated that the most important function of the omentum was revascularization, rather than anti-inflammatory action. Histologic study of the intestine at various intervals following injury showed a smaller amount of vascular damage in loops protected by antibiotics. The vascular injury was not sufficient to render the loops nonviable, but the superimposed bacterial action so aggravated the degree of vascular occlusion as to be responsible for the death of the loop and eventually for the death of the animal. In loops with adequate antibacterial protection, the eventual death of the loop was prevented, and survival was achieved. No single organism was regarded as the exclusive source of vascular injury, and it was suggested that bacterial synergism was responsible for the death of many animals. This synergism may explain partially the relative effectiveness of some antibiotics. The authors concluded that "these experiments demonstrate that bacterial action is a major factor in the conversion of a sublethal to a lethal degree of vascular injury of the dog's gut" (133). "Oral aureomycin facilitated the re-establishment of adequate blood flow in a loop of the dog's intestines subjected to vascular injury. . . . Revascularization and survival of the loop is facilitated by inhibiting the normal intestinal flora, which, in the untreated animal, impedes the development of collateral circulation" (132).

The use of antibiotics for preoperative sterilization of the bowel was thoroughly reviewed by Riddell (137). On the basis of extensive clinical application, Dearing, Heilman, and Needham (45, 46, 47) concluded that aureomycin and terramycin were the most effective agents for

preoperative intestinal sterilization prior to large bowel surgery. More recently, workers from the same institution have decided that the best agent for preoperative bowel antisepsis is neomycin (130B). Cohn and Longacre (39A, 39B, 39C) studied the quantitative reduction in the fecal flora of patients following various types of preoperative preparation and concluded that achromycin combined with neomycin, or nystatin combined with neomycin were superior to all other antibacterial agents for this purpose.

Cohn, Gelb, and Hawthorne (35, 36) utilized preoperative bowel sterilization in an attempt to prolong survival further in experimental strangulation obstruction. Venous strangulation of a 30 centimeter segment was utilized. One series of dogs was prepared with sulfathalidine and streptomycin given by mouth, while another series was prepared with aureomycin given orally. All received penicillin intramuscularly and aureomycin intravenously in the postoperative period. Results in the two series were comparable. The average survival, 71.5 hours, was twice the length of survival obtained in animals that did not receive antibiotics. In addition to the strangulated bowel, there were autopsy findings in almost every animal which were thought to have contributed to the death of the animal. (This included strangulation of an additional length of bowel, intussusception, consolidation of the lungs, and perforation in the viable portions of the obstructed segment.) Culture of the bowel lumen at operation confirmed the value of preoperative intestinal antisepsis. The majority of peritoneal fluid cultures were negative, further indicating the value of intestinal antisepsis. Attempts to demonstrate lecithinase in the peritoneal fluid and bowel contents were unsuccessful. Furthermore, the validity of the usual lecithinase test was questioned by the authors, since many nonspecific factors were found to contribute to the turbidity reading in the test (59A). The histologic changes in the strangulated bowel were in marked contrast to those observed in dogs not receiving antibiotics. In the antibiotic series there was uniform thickening of the bowel wall with hemorrhage and/or edema. There was excellent preservation of the mucosal layer, in contrast to its universal destruction in the nonantibiotic series. Bacteria were rare in the bowel wall in the antibiotic group in contrast to their enormous numbers in the nonantibiotic series. The preservation of the relatively normal histologic appearance of the bowel wall in the antibiotic series was an important observation in this group of experiments. Since the use of antibiotics was the only difference between this series and a similar series of experiments by Nemir, Hawthorne, Cohn, and Drabkin (119), the differences in appearance of the bowel and in the survival time must have been due in significant part to the absence of the rapid, destructive influence of bacteria. Why further survival was not obtained could not be explained until other workers demonstrated that large intravenous doses of aureomycin could be toxic (76, 104, 105, 138, 141, 143, 183). It then became obvious that aureomycin had been given intravenously in a toxic range throughout the series. Furthermore, there were histologic changes in the liver compatible with those described for aureomycin toxicity, and the death of some of the experimental animals which could not be explained otherwise was attributed to the toxicity of the aureomycin given intravenously. This suggested that if the drug could be given by some nontoxic route further beneficial effects might be obtained. This was further substantiated by the work on strangulation of the ileum of dogs by Rabinovici and Fine (132, 133). Cohn and his associates (35, 36) concluded: (1) that bacteria could be almost completely reremoved from the dog bowel by antibiotics given preoperatively by mouth, (2) that the bacterial flora of the postoperative peritoneal fluid could be effectively controlled, (3) that blood loss during the survival period was less than in similar experiments without antibiotics, and (4) that the improved survival with adequate preoperative bowel sterilization and postoperative antibiotic protection demonstrated the significant role of bacteria in experimental strangulation obstruction.

Morton, Furth, Hinshaw, and Schilling (114) attempted to evaluate aureomycin in strangulation obstruction. Strangulation was produced by ligating all vessels to a 30 centimeter segment of small bowel. During surgery the animals received saline solution intravenously, but postoperatively they received only water by mouth until death. This was not adequate therapy for an experimental animal with strangulation obstruction of the small bowel. The control group had an average survival time of 62 hours. Perforations were found in every control animal, and were relatively common in the treated

groups. The maximum average survival, 132 hours, was obtained in the animals receiving postoperative treatment. The inconsistent clinical behavior of these animals in the postoperative period may perhaps be explained partly by the fact that death in some animals was undoubtedly due to peritonitis, whereas in other animals it was attributable in large part to blood loss. The conclusion of Morton and his associates that "animals treated pre-operatively or during both pre- and postoperative periods fare little better than untreated controls" does not seem entirely justifiable since the postoperative care of these animals was not as thorough as it should have been for proper evaluation of the role of aureomycin in this problem.

Cohn (30, 30A) found a means of using aureomycin without toxic effects and was able to achieve indefinite survival in experimental strangulation obstruction. Dogs were prepared for 6 days with aureomycin given orally and for 2 days with penicillin given intramuscularly. Following surgery aureomycin was introduced into the strangulated segment by means of a plastic tube which was threaded into the strangulated segment at surgery. Postoperative therapy included penicillin given intramuscularly, electrolytes, gelatine, and blood. The dogs in this series were reoperated upon 118 to 142 hours following strangulation, at which time the strangulated segment was resected and intestinal continuity restored. The time for reoperation was selected on the following basis: (1) it should exceed the previous maximum survival in strangulation obstruction—116 hours; (2) the stable clinical condition of the animal indicated that further observation would not be profitable; (3) the possibility of a nutritional death, which increased each day since it was impossible to supply adequate nutrition intravenously, should be avoided; and (4) reoperation revealed that the bowel had returned toward a normal appearance so that the possibility of death from strangulation per se had been avoided. The peritoneal fluid in these animals never changed to the dark, foul-smelling, or hemolyzed fluid observed in the nonantibiotic animals. Clostridia were not found in the peritoneal fluid of these animals, which further attested to the value of preoperative bowel antisepsis. The blood, gelatine, and electrolyte requirements in these animals were significantly lower than those of either the nonantibiotic animals or the animals which received aureomycin intravenously in the postoperative period. The total output was likewise significantly lower, as were its components—peritoneal fluid, urine, and vomitus. The loss of blood into the gastrointestinal tract and the amount of hematemesis were insignificant compared with those in the previous series, which partially explained the decreased need for blood in this series. Likewise the diminished vomiting in this group partially explained the smaller requirements for electrolyte replacement. The decreased need for blood and electrolytes has not yet been thoroughly explained. Important observations in this group were the finding of a segment which had retained its viability in spite of complete venous strangulation. The strangulated segment was thicker, shorter, and smaller in circumference than normal because of hemorrhage, edema, and contraction of the muscular wall. The serosal surface showed only some underlying hemorrhage. The mucosal surface was not distinguishable from the immediately adjacent normal mucosa. The reduction in bacterial flora prior to operation and the maintenance of a reduced bacterial flora in the strangulated segment following strangulation must have played a significant role in permitting the mucosa to retain its normal characteristics since the use of antibiotics and their method of administration were the only ways in which this series differed from previous series. Even microscopically the histologic appearance of the strangulated bowel was within normal limits except for some hemorrhage and edema of the muscular coat. This work demonstrated that when the bacterial flora can be kept to a minimum, dogs with strangulation obstruction can be kept alive indefinitely. The importance of the bacterial phase of toxicity in strangulation obstruction was thus established.

More recently, Cohn (32, 32A) obtained comparable results without the benefit of preoperative bowel sterilization. All antibiotic therapy was limited to the postoperative period. Achromycin was administered through a plastic tube directly into the strangulated segment. Since this eliminated preoperative bowel sterilization and circumvented the objections that preoperative antibiotic therapy was of no clinical usefulness, the importance of bacterial control in the postoperative period was significantly strengthened by these studies.

Further evidence of the importance of bacterial control has been provided by Cohn and

Rives (39D) in a study of antibiotic protection of devascularized colon anastomoses. Animals without any preoperative preparation did not survive devascularization of one side of a colon anastomosis. A similar series with postoperative intracolonic antibiotic administration through a plastic tube did survive. If antibiotics can achieve results like this in the presence of the high bacterial content of the colon, there should be less question about the ability of antibiotics to exert a significant role in the small bowel, where the bacterial population is comparatively small.

The use of a Thiry fistula preparation for the study of strangulation obstruction has been advocated because it avoids many complicating factors that have confused this subject in the past (31). Preliminary results (33) with this type of preparation indicate that death can occur in the absence of all secretions except those of the fistula. If certain bacteria are present in the strangulated Thiry fistula, death results. Further studies with this technique are certainly indicated.

The emphasis in recent work has thus been more and more frequently directed toward the importance of the bacterial factor in strangulation obstruction and further study of this portion of the problem is to be desired.

SUMMARY

The obstructed small bowel presents ideal conditions for the growth of the Clostridium welchii. In strangulation obstruction, conditions are further improved.

Experimentally and clinically, the growth of the Clostridium welchii is tremendously stimulated in the obstructed bowel and there is a significant quantitative increase in the number of organisms above the obstruction. There are conflicting clinical and experimental reports regarding the efficacy of Welch antitoxin in obstruction. Normal intestinal contents, which are nontoxic when injected into normal animals, have repeatedly been shown to become toxic after incubation. The effects of intestinal contents treated by various means to exclude enzymes or other secretions, but not to exclude bacteria, have emphasized the importance of bacteria in producing this toxicity. Sterile bowel (such as that obtained from newborn animals or from a fetus removed under sterile conditions) has been placed in the peritoneal cavity of normal animals without ill effect. Contaminated bowel causes death of the animal into whose peritoneal cavity it is placed. Bacteria grown in the intestinal wall have been blamed for this. The organisms are capable of killing the host animal in the absence of food or any gastrointestinal secretions. The various toxic agents are not absorbed by normal gastrointestinal mucosa. The toxin is without effect as long as it remains within the gastrointestinal tract, or as long as it remains in the lumen of the gastrointestinal tract with normal mucosa. Absorption of the toxin is aided by circulatory damage to the bowel wall. Venous occlusion of a segment of bowel without obstruction may not be fatal, provided adequate preoperative antibacterial therapy has reduced the gastrointestinal bacterial population. Penicillin prolongs the life of animals with isolated, closed loops of bowel, or with strangulation obstruction. Clostridial toxin, clostridial cultures, or filtrates of clostridial cultures have varying effects in different animal species, and it is not always possible to transfer results from one species to another. In strangulation obstruction of long loops of bowel, death is due to blood loss. In strangulation of short loops of bowel, death is due to perforation and peritonitis. Welch antitoxin is not, and should not be expected to be, effective in simple obstruction, since death is due to fluid and electrolyte imbalance.

Thiry fistula studies on the importance of distention and the cause of death in obstruction must be carefully evaluated with a knowledge of the distending pressure utilized. Pressures higher than 10 millimeters of mercury produce vascular damage and therefore introduce the complication of necrosis of the bowel wall.

Fresh "sterile" liver or fresh intestine in the peritoneal cavity of a normal dog causes death of the host animal. Fragments of the spleen or kidney do not produce death so consistently nor so rapidly. Death is usually associated with a bloody, frothy, hemolyzed peritoneal fluid, and with hemorrhages in many viscera. Some workers attribute this death to products of autolysis of tissue undergoing necrosis in the peritoneal cavity. These studies are important in understanding strangulation obstruction because intestinal tissue undergoes autolysis following strangulation.

The presence of bacteria normally resident in apparently healthy, sterile tissue must not be forgotten in any study such as this. This is true particularly with regard to studies involving dogs as the experimental animal. The prevalence of

the Clostridium welchii in the vast majority of normal, healthy dog tissues has been repeatedly established. An isolated loop of bowel can be sterilized by prolonged contact with the peritoneal cavity. Subsequent strangulation of this loop is without effect, provided the loop has actually become sterilized. Under these circumstances the re-introduction of bacteria produces a fatal outcome, so that the lethal toxins may be attributed to the action of bacteria on necrotic tissue. The organism found in the liver of dogs has been identified as the Clostridium welchii. The toxic element in intraperitoneal autolysis of dog liver is attributed to bacteria resident in, and growing on, the autolyzing liver.

Normal gastrointestinal contents of animals are toxic according to some observers and nontoxic according to others. The discrepancy cannot be explained completely at the present time. The transudate around a strangulated loop and the contents of a strangulated loop produce a leucopenia in the recipient animal.

Adequate treatment with fluids, electrolytes, blood, and plasma prolongs survival in experimental strangulation obstruction beyond that achieved by any previous methods. Shortly before death, there are significant spectrophotometric, chemical, bacteriologic, and gross changes in the peritoneal fluid. Cultures of the early peritoneal fluid are frequently sterile, but the late peritoneal fluid and that obtained at death usually contain all the organisms present in the bowel at the time of strangulation.

Spectrophotometric studies reveal a newly described pigment in the strangulated bowel shortly after strangulation, then in the peritoneal cavity, and later in the blood stream. This movement indicates the route of absorption of the pigment and suggests that any toxic agent would be absorbed by the same route. The appearance of toxicity is correlated with gross, spectrophotometric, and chemical changes in the peritoneal fluid. The early, pink peritoneal fluid is not toxic, but the late, dark peritoneal fluid is lethal when injected intraperitoneally or intravenously. Toxicity of this fluid is partially correlated with the spectrophotometric concentration of the newly described pigment. However, the toxic agent is not identified as the altered pigment. Animals dying from injection of the late peritoneal fluid present an autopsy picture which is quite similar to that of animals dying from strangulation obstruction.

Clinical study of patients with strangulation obstruction indicates a better correlation between the bacteriologic content of the peritoneal fluid and the clinical course than between the spectrophotometric findings in the peritoneal fluid and the clinical course.

In vitro studies of the newly described pigment show it to be a derivative of hemin. A similar but not identical pigment can be produced by the interaction of blood with various substances found in the strangulated segment, the best results being obtained with activated pancreatic juice and blood. The mixture so obtained is lethal when given intravenously in small doses. Activated pancreatic juice mixed with plasma is toxic without producing the abnormal pigment, but bacteria and their toxins have not been excluded from this study.

Duodenal secretions are not essential for a fatal outcome in strangulation obstruction as demonstrated by the use of a two-phase procedure utilizing a modified Mann-Williamson operation to divert the duodenal contents below an area subsequently strangulated and obstructed.

A close correlation has been observed between the toxins of the Clostridium welchii and the fatal outcome in both experimental peritonitis and strangulation obstruction. Lecithinase, the alpha toxin of the Clostridium welchii, is thought to be responsible for many of these effects. The detection of lecithinase in the peripheral blood of animals with strangulation obstruction has not been demonstrated successfully, but lecithinase has been found in the thoracic duct, and its absence from the peripheral blood is attributed to its rapid binding by the red cells.

The combination of sublethal doses of the Clostridium welchii with sterile segments of bowel placed in the peritoneal cavity of normal dogs produces a fatal outcome similar to that seen in strangulation obstruction. Therefore, many of the results in strangulation obstruction are attributed to the growth of the Clostridium welchii in the autolyzing bowel and the absorption of the toxins produced under these conditions. Sterile devascularized bowel has no effect in the peritoneal cavity of normal dogs.

Penicillin given parenterally, or penicillin placed in a closed, isolated loop of bowel significantly prolongs life in strangulation obstruction or closed loop obstruction. However, the prolongation of life is still limited. Reduction of the gastrointestinal bacterial flora by poorly ab-

sorbed sulfonamides protects the ileum of dogs with venous strangulation of long segments. Animals without sulfonamide protection die rapidly with perforation of the involved segment and spreading peritonitis. Re-establishment of the circulation occurs from the omentum, the mesentery, and adhesions to the normal bowel. Microscopic examination of such segments of bowel reveal it to be indistinguishable from the normal. Comparison of the sulfonamides administered by various routes reveals the maximum effect to come from sulfonamides given prior to vascular injury. The viability of segments of bowel subjected to a temporary venous strangulation is preserved by penicillin. Aureomycin administered by varying routes and for varying periods also has been found to have a highly beneficial effect on segments of bowel subjected to venous strangulation.

With proper antibiotic protection, indefinite viability of obstructed, strangulated segments of bowel can be maintained, in contrast to the rapid death which occurs without antibiotic protection. The omentum may be one of the critical sources of blood supply in the period immediately following vascular injury but it is not essential, as demonstrated by survival experiments in animals with the omentum excised. Preoperative bowel sterilization with aureomycin or sulfonamide plus streptomycin, combined with aureomycin given intravenously and penicillin given intramuscularly after operation, prolongs survival in dogs beyond that of previously tried techniques. Indefinite survival is not obtained by this means either. Aureomycin given intravenously in large doses is hepatotoxic and lethal when administration is continued beyond a critical period.

Preoperative bowel preparation with aureomycin combined with postoperative penicillin given intramuscularly and aureomycin delivered directly into the strangulated obstructed bowel by means of a plastic tube inserted in the bowel at surgery, provided the ultimate means of obtaining indefinite survival in dogs with strangulation obstruction. Resection of the strangulated segment 5 to 7 days following strangulation reveals that the strangulated segment has returned essentially to normal. Microscopically, there is minimal change from the normal. Blood loss and fluid requirements are markedly reduced in animals with preoperative bowel antisepsis. Similar results are obtained when all antibiotic therapy is limited to the postoperative period, which indicates the importance of adequate control of the bacterial flora of the strangulated bowel.

These results have a definite place in the development of our knowledge about strangulation obstruction and they must be considered significant advancements in the study of this condition, even though immediate clinical application was not the aim of the experimental workers. While these results have shown that antibiotics do contribute to the over-all improvement in results in experimental strangulation obstruction, there has been no striking evidence thus far that antibiotics have improved the mortality in clinical strangulation obstruction. None of the authors who have contributed to this problem have implied that any patient with strangulation obstruction should be treated with antibiotics in place of surgery. Such an idea is not proposed even as the result of this survey, which indicates the value of antibiotics in extending knowledge about this field. The various contributions utilizing different types of antibiotic therapy to extend the knowledge about strangulation obstruction have been valuable, but would lose all of their importance, and would indeed be dangerous, if they were misinterpreted to mean that antibiotics should replace surgery in the care of a patient with strangulation obstruction.

Following strangulation, bacteria are thought to invade the intestinal wall, and by their growth and production of toxins are thought to increase vascular permeability and to destroy the bowel wall. This leads to further blood loss, hematemesis, and general fluid loss. It also increases the permeability of the bowel wall and permits the gastrointestinal contents to permeate the bowel wall and find their way into the peritoneal cavity. Absorption from here into the systemic circulation causes death of the animal. Adequate preoperative intestinal antisepsis either completely controls the bacterial flora or so reduces it as to permit the body's normal defenses to combat bacterial activity and thus regain viability for the strangulated segment. Reproduction of these results with antibacterial therapy restricted to the postoperative period strengthens this theory.

The use of adequate bowel antisepsis to prolong life indefinitely in dogs with strangulation obstruction demonstrates the vital role of bacteria in the cause of death of patients with strangulation obstruction.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Temporomandibular Joint Ankylosis with Mandibular Retrusion. VARAZTAD H. KAZANJIAN. *Am. J. Surg.*, 1955, 90: 905.

A CASE of temporomandibular joint ankylosis, essentially of unknown etiology and associated with an extreme degree of retrusion of the mandible, is presented. The treatment involved (1) restoration of movement of the lower jaw, and (2) correction of the deformity.

The first problem was corrected by a temporomandibular arthroplasty which gave the patient excellent mobility of the jaw. Six years later, corrective procedures were performed by doing bilateral L-shaped osteotomies through the mandible, with care to preserve the inferior alveolar nerves. Fibrous union was allowed to occur in these osteotomies, and one year later bone grafts were inserted to increase the length of the mandible. The contour of the chin was also improved with a bone graft at this time. Postoperative photographs of the patient indicated an excellent cosmetic result. —*Harold M. Unger, M.D.*

The Surgical Correction of Complete Bilateral Ankylosis of the Mandible; Report of a Case. ROBERT W. CHRISTENSEN. *Oral Surg.*, 1955, 8: 1235.

THE TEMPOROMANDIBULAR JOINTS are not frequently affected by rheumatoid arthritis, and where the disease is generalized, may be the last joints to be affected. Pain, edema, and a sensation of warmth are usually the earliest symptoms in these joints. The edema may cause a displacement of the articular surface of the condyle and where there are edema and inflammatory reactions, trismus and severe pain occur during normal mastication. If the disease progresses, a fibrous or osseous ankylosis is the result.

A 59-year-old woman, completely bedfast for 14 years because of generalized rheumatoid arthritis, had had complete ankylosis of the mandible for 10 years. During this time, when it had been impossible to perceive even the slightest movement of the mandible, the diet had consisted of liquids and soft foods which could be forced, with the fingers, around the six remaining lower incisors. Roentgenologic examination showed sclerosis of both temporomandibular joints, especially on the right where the joint was narrowed and barely visualized. There was no evidence of ossification of any of the masticatory musculature, and upon asking the patient to attempt to open her jaws, it was possible to see the functional attempt of most of the suprahyoid muscles. Because of the ankylosis, intraoral examination was not possible. A blind nasoendotracheal intubation was accomplished for purposes of anesthesia. The right temporomandibular joint was exposed through a preauricular incision, about 4.0 centimeters in length. The superficial temporal artery and vein and the superficial orbital vessels were ligated and divided. The posterior superior attachment of the masseter muscle was incised along the zygoma and reflected anteriorly. A vertical incision was made through the periosteum over the greatly enlarged condyle, which was entirely fused with the glenoid fossa and zygomatic process of the temporal bone. An ostectomy was accomplished through the center of the bony mass of condyle by the aid of surgical carbide burrs, chisel, and mallet, and a horizontal segment, 1.0 centimeter thick, was removed. The roughened bone-edges were rounded with a bone file. The wound was closed around a Penrose drain. In order to allow the mandible to remain in concentric relationship while healing occurred, the operation on the left condyle was delayed six weeks. On the third day following the second operation, during which the mouth had been forced open approximately one inch, the patient was encouraged to use the mandible. For a while there was moderate pain and a grating noise in the newly formed joint spaces, which gradually disappeared over an eight-week period. She was then fitted with dentures. One year postoperatively, she has no discomfort and functions very well. The vertical degree of opening has increased gradually along with some lateral and protrusive excursions and she is able to use her jaws with complete ease. —*David T. Petty, M.D.*

Surgical Reconstruction of the Temporomandibular Joint. ORION H. STUTEVILLE and ROBERT P. LANFRANCHI. *Am. J. Surg.*, 1955, 90: 940.

THREE IMPORTANT ALTERATIONS of the temporomandibular joint require surgical reconstruction of the condylar portion of this joint. They are (1) condylar fractures, (2) ankylosis, and (3) destruction of the growth center of the condyle.

Condylar fractures have been discussed frequently but extracapsular fractures with displacement of the condyle have been treated with neglect, leading to malocclusion and jaw deformities. The authors believe that the best method of management is internal fixa-

tion in the normal alignment, when this is feasible. Ankylosis occurs as the result of an intracapsular or extracapsular fracture, or may occur following birth trauma. Arthritis, syphilis, and certain other medical diseases may terminate in ankylosis. The condition is best treated by inserting a cartilage graft at the articulation or by creating a pseudarthrosis in the ramus just inferior to the articulation.

Disturbances of the growth center of the condyle are treated by a new procedure which is described by the authors. They resect the head of the condyle and replace it with the head of a metatarsal or the medial femoral condyle. These sites are chosen in order to give a graft with a growth center which may continue to grow as the child grows, and allow for the continued growth of the mandible which, if not present, would result in a continuation of the deformity. No follow-up studies of this procedure are mentioned but the logic of the operation is apparent.

—*Harold M. Unger, M.D.*

Some Aspects of the Problem of Radionecrosis of the Jaws. W. DONALD MACLENNAN. *Proc. R. Soc. M.*, Lond., 1955, 48: 1017.

THE MANDIBULAR and maxillary regions, like the sole of the foot and the skin of the lower limb, are most prone to the adverse effects of irradiation. The type of irradiation, the dosage, and the method of administration are directly related to the tissues (skin, connective tissues, muscle, bone, dental structures, nerve tissue, vessels, salivary glands, mucous membrane) exposed. Overdosage and "scatter" (leakage of radiation in the surrounding tissues) and the superimposition of trauma and/or infection are predisposing factors. Radionecrosis is the result of permanent damage to the local blood supply and the effects remain as long as the patient may live. The loss of blood supply may jeopardize the chance of success of future surgical intervention. This sequence of changes has added significance if the tumor cells are not destroyed by irradiation but are merely temporarily walled off by a limiting barrier of fibrous tissue. The author believes that teeth play an important role in osteoradionecrosis of the jaws, and he favors extraction with the sockets healed prior to irradiation.

The clinical signs and symptoms of radionecrosis include cachexia, anorexia and weight loss, pain aggravated by motion, edema, necrosis, osteitis, trismus, and hemorrhage. Treatment includes a high caloric diet, given by nasogastric tube if necessary, control of pain by analgesics, nerve blocks, or even prefrontal leucotomy, control of infection by establishment of strict oral hygiene and antibiotics, and surgical removal of the necrotic tissues insofar as, and whenever, possible. Respiratory embarrassment may demand tracheotomy.

The author concludes that most of the lesions which can be dealt with successfully by the radiologist are amenable to surgery. He prefers radiotherapy after surgery when indicated. Mowlem, discussing the paper, agreed that the damage done by a good surgeon cannot be as irreparable as the damage which may be done by even a good radiotherapist, and further, that after surgery the remaining tissues afford the opportunity for reconstruction. He stated that wherever good surgery offers even a reasonable alternative to good radiotherapy, surgery should be chosen; surgery cannot inflict pain beyond the immediate postoperative period nor produce continuing avascularity and massive necrosis. He made a plea that radiotherapy be recognized as palliative treatment and that it be administered under the joint aegis of the radiologist and the surgeon.

—*Edwin J. Pulaski, M.D.*

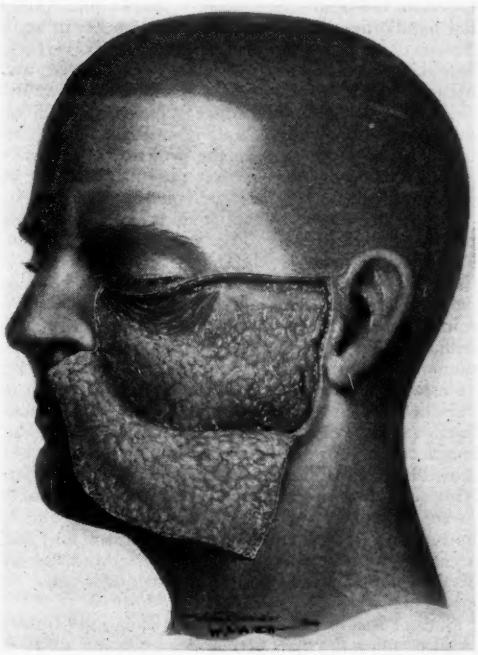


FIG. 1 (Maguire *et al.*). Suborbital approach (authors' method).

Tumors of the Cheek; Observations on Etiology, Differential Diagnosis, and Methods of Surgical Approach. CARTER P. MAGUIRE, CHARLES E. HORTON, and KENNETH L. PICKRELL. *Arch. Surg.*, 1955, 71: 896.

THE CHEEK is the mobile portion of the lateral wall of the oral cavity, extending from the orbit to the mandible and from the masseter muscle to the nasofacial sulcus. Between the outer skin and internal mucous membrane lies muscle, nerve, lymphatic, connective, glandular, vascular, ductal, and adipose tissue, all of which are subject to inflammatory and vascular changes. Lesions of the cheeks may be divided into two major groups: (1) those involving the surface coverings of the cheeks, and (2) deeper masses in the cheek.

Basal-celled and squamous-celled carcinoma of the skin of the face are the most frequent malignant conditions, while squamous-celled carcinoma of the buccal mucosa is much less common. Other commoner lesions of the mucous membrane of the cheek are leu-

coplakia, hemangioma, mucocele, and benign epithelial papillomas. Surface lesions of the cheek, in addition to cancer, include nevi, hyperkeratosis, verruca, hemangiomas, cutaneous fibromas, cylindromas, and hydradenomas. In the great majority of cases an excisional biopsy is the procedure of choice, thereby establishing the diagnosis and completing the treatment in one procedure. In the presence of extensive lesions it is recommended that the diagnosis first be made by biopsy and the treatment planned accordingly.

Subsurface lesions of the cheek present interesting problems in diagnosis. The masses may represent solid or cystic tumors which may arise from the soft tissues of the cheek or from the underlying bone or dental apparatus. They include: nerve tumors (neuromas, neurofibromas or gangliomas), which are rare; hemangiomas and lymphangiomas, which are common and easy to diagnose since there is almost always an associated involvement of the surface coverings of the cheeks; hemangioepitheliomas—the rapidly malignant variety of this type of tumor; sebaceous cysts, characteristically not movable under the skin but movable freely with the adherent skin over the underlying subcutaneous tissue; dermoid cysts, located only in the region of the nasolabial fold on the cheek; lipoma and liposarcoma, which are uncommon; and accessory parotid salivary gland tumors and tumors of the parotid duct, positively diagnosed only by histologic study.

Surface lesions are treated by excision and primary closure, unless the defect created is large and a sliding flap is necessary.

Subsurface lesions not suspected to be malignant, and deep to the buccinator fascia, may be removed by the intraoral route, care being taken to identify and preserve the parotid duct. In the extraoral approach, the surgeon has a choice of several procedures. The authors are averse to direct incision unless previous scars or skin lesions which require excision are present. They describe in detail the paranasal incision, the submandibular approach, the preauricular approach, and a combination of the last two methods. Their own method, the suborbital approach, also is described and is recommended for operations on the cheek (Fig. 1) which cannot be adequately explored through simpler incisions. The advantages claimed are widespread exposure of the cheek, optimal cosmetic results, minimal morbidity in the form of postoperative edema, no necessity for endotracheal anesthesia, and no impairment of the local blood supply. If a malignant tumor is found at operation, it is managed in the usual manner; i.e., wide local excision, with radical neck dissection, if indicated, four to six weeks later. —*Edwin J. Pulaski, M.D.*

EYE

Experience in the Clinical Examination of Corneal Sensitivity; Corneal Sensitivity and the Nasolacrimal Reflex After Retrobulbar Anesthesia. JØRN BOBERG ANS. *Brit. J. Ophth.*, 1955, 39: 705.

IN TESTING corneal sensitivity, the author substitutes a nylon thread for von Frey's hairs since nylon has constant physical properties while the power of a hair varies with atmospheric humidity. He employs a holder of his own design, by which the length of a standard nylon thread (diameter 0.11 inch) can be varied from 5 to 55 millimeters. The thread is gently applied at right angles to the cornea and the bending should not exceed 5 per cent of its free length. The force is calibrated in milligrams. The cornea is tested at its center and at 4 to 8 paralimbal points.

With this technique, constant reproducible results are obtained. In young people the sensitivity at the corneal center is 15 milligrams, near the limbus 20 milligrams, and on the bulbar conjunctiva, 70 milligrams. The sensitivity decreases with advancing age. It also decreases in glaucoma with a tension of above 30 mm. Hg., in chemical injuries of the cornea, in corneal ulcers, herpes, herpes zoster, corneal dystrophy, cystinosis of the cornea, and after diathermy for retinal detachment. With the use of retrobulbar anesthesia the corneal sensitivity is decreased before the nasolacrimal reflex is diminished. The addition of hyaluronidase to the retrobulbar injection causes a more even diminution of corneal anesthesia.

—*James E. Lebensohn, M.D.*

The Treatment of Gross Corneal Opacification by Lamellar and Annular Lamellar Keratoplasty. A. G. LEIGH. *Brit. J. Ophth.*, 1955, 39: 641.

THE AUTHOR states that perforating keratoplasty is most successful in cases of small, central corneal nebulae and keratoconus, because in these conditions the graft is completely surrounded by healthy cornea. He believes that for a perforating graft to survive as a clear structure it must be placed in a cornea of recognizable structure and that opacities must not exceed two-thirds of the area in thickness of the cornea in contact with the graft. Where there is gross opacification extending widely throughout the thickness of the cornea, a simple perforating graft rapidly becomes completely opaque and takes on the characteristics of the tissue in which it is placed. This is especially true if degenerative changes are present and is accelerated by vascularization within the recipient cornea.

Lamellar graft placed in an opaque cornea frequently survives as clear corneal tissue and the author believes that when such a lamellar graft has remained clear for a period of 6 months, a smaller perforating keratoplasty may be successfully performed through its center. He suggests this method of dealing with a dense nonvascularized opacity, no larger than 7 by 8 mm., where the peripheral zone of the cornea is clear. He acknowledges that such an opacity could be treated by a single large perforating graft, but believes that this would be more difficult and hazardous because of the attendant complications of anterior and peripheral anterior synechiae which might occur due to late reformation of the anterior chamber; also it is difficult to assess the suitability of the peripheral cornea to support such a large graft.

In cases of gross corneal opacification, it was observed that after lamellar keratoplasty the graft remained clear and free of vascularization, but that a dense vascular network developed between the recipient cornea and the graft, and it was found that this vascularization had to be destroyed before a perforating graft could be successfully placed through the lamellar graft. Irradiation and peritomy were usually

unsuccessful and the author developed the procedure of placing an annular lamellar graft outside the central lamellar graft with an intervening thin ridge of recipient cornea between the two. This operation proved to be a successful method of considerably reducing the vascularization beneath the lamellar graft and establishing suitable tissue through which a perforating graft could be placed.

The operation, in which a 6 mm. central lamellar graft is initially performed, followed later by the annular graft and eventually by the central perforating graft, is described in moderate detail. Three case histories are briefly reviewed.

—*Andreas V. Mortensen, M.D.*

Aqueous Pathways in Some Cases of Glaucoma. GEORGIANA DVORAK-THEOBALD and HAROLD QUENTIN KIRK. *Am. J. Ophth.*, 1956, 41: 11.

AS AN INTRODUCTION to the present study, the authors give a brief recapitulation of the importance of aqueous vessels (based on work done by various investigators) in relation to ocular pressure. They discuss in detail the pathologic changes occurring in the canal of Schlemm, the trabecula, and the intrascleral vessels in glaucomatous eyes, viz.:

1. Obliteration of the lumen of Schlemm's canal.
2. Early narrowing of the intrascleral veins
3. Narrowing of the external collector channels
4. Complete collapse of the external collector channels and intrascleral veins
5. Narrowing of the episcleral vessels
6. Sclerosis and thickening of the trabecular fibers

The average width of the intrascleral vessels in glaucomatous eyes was smaller than in natural eyes. Some glaucomatous eyes showed marked narrowing of the intrascleral vessels with a normal canal of Schlemm and trabecula. The narrowing was found to be passive, and not due to proliferation of the endothelial walls. This passive change developed as the result of an increase in size of the collagenous fibers of the sclera, along with their hyalinization, both changes being progressive with age. In some cases of simple chronic glaucoma, the development of these changes was advanced as a probable cause.

—*Albert C. Frell, M.D.*

Cyclodiathermy; Results in Various Types of Glaucoma. SHERMAN B. FORBES. *Am. J. Ophth.*, 1955, 40: 650.

FORBES discusses cyclodiathermy and its results in various types of glaucoma. Diathermy by the ciliary-body approach was introduced in the 1930's. Vogt, in 1936, first described the use of perforating cyclodiathermy in glaucoma. At that time the perforations were placed in three rows, the closest being 2.5 millimeters from the limbus. In the early days of cyclodiathermy the operation consisted of perforation, partial perforation, or surface coagulation up to 2.5 to 4 millimeters from the limbus. At midcentury the possibility of inhibiting the ciliary nerves to, or diminishing the blood supply of, the ciliary body with subsequent atrophy entered the picture. With this in mind, Reiser advocated placing the punctures 8 millimeters from the limbus. Other surgeons approved and followed this procedure with some modifications.

The author's technique is as follows: Accurate marking is made on the sclera 8 millimeters from the limbus in each of the two lower quadrants, after having incised the conjunctiva from the lower border of one horizontal muscle to that of the other. About 30 coagulation punctures are made on a 6 and on an 8-millimeter arc, with at least 15 punctures in each lower quadrant of the bare sclera. A 1-millimeter electrode is used, with current adequate to produce a browning of the sclera; the applicator is kept in contact for two or three seconds. The sclera should be dry and the cornea treated with profound surgical respect.

If a second operation is desirable, it can be performed superiorly; if a third operation is required it is performed immediately in front of, and behind, the insertion of the internal and external recti in the region of the long ciliary vessels and nerves.

The conjunctiva usually is closed with a continuous No. 6-0 silk suture or with absorbable plain catgut. Eserine ointment and an antibiotic ointment are introduced into the eye and both eyes are patched.

From his experience in a series of 80 cases, the author concludes that cyclodiathermy is potentially valuable in congenital glaucoma, in open-angle glaucoma, in narrow-angle (iris-block) glaucoma (although to a lesser degree), in glaucoma associated with congenital defects of the eyeball, and in secondary glaucoma of all types. It is especially valuable in combination with operative procedures such as cataract extraction, acts like a posterior sclerotomy or an iridectomy, and as a preliminary operation prior to cataract extraction. In combination with iridectomy, in the treatment of congestive glaucoma, cyclodiathermy is advantageous in that it enables performance of the iridectomy on a soft eyeball.

The procedure proved successful in 11 of 14 aphakic eyes, the intraocular pressure in the remaining 3 eyes being normalized later by cyclodialysis.

Heretofore operations for glaucoma were designed to eliminate the aqueous. The newer methods, namely, cyclodiathermy and cycloelectrolysis, aim to decrease the production of aqueous.

—*Joshua Zuckerman, M.D.*

Uveitis; a Clinical and Statistical Survey. GEORGE BENNETT. *Brit. J. Ophth.*, 1955, 39: 727.

AMONG 332 CASES of primary uveitis investigated in this study, the distribution was as follows: collagenous disease, 20 per cent; local virus infection, 38 per cent; granulomatous disease, 5 per cent; and unclassified types, 37.5 per cent. Over one-fifth of the patients with the classification of virus infection suffered from superficial punctate keratitis at some time. Bilaterality was associated more often with superficial punctate keratitis than with herpetic lesions. Under 15 years, uveitis is rare, its incidence being but 2 per cent. In the present series the unilateral incidence of uveitis was 13 per cent in granulomatous disease but in the other groups approximated 65 per cent. Using the age of 40 as a reference point, the incidence above and below this age is approximately equal in all groups except that of granulomatous uveitis in which the incidence under 40 years of age is 80 per cent.

Of 5 patients in the unclassified group given antituberculous chemotherapy, 3 were permanently cured.

Treatment with tuberculin is condemned. Complicating ocular hypertension was most frequent in the viral group. The duration of activity in any group was not significantly affected by cortisone.

—*James E. Lebensohn, M.D.*

Oxygen Inhalation in Retinal Arterial Occlusion; a Preliminary Report. ARNALL PATZ. *Am. J. Ophth.*, 1955, 40: 789.

THE AUTHOR discusses the effects of oxygen inhalation in retinal arterial occlusion.

Oxygen therapy is valuable in ischemic processes throughout the body, especially in acute coronary vessel occlusion. In retinal arterial occlusion the vascular choroid, the circulation of which is intact, lies in direct apposition with the avascular retina. If the arterial occlusion is total, all the blood-borne constituents (oxygen, glucose, metabolites, etc.) normally directed to the inner layers of the retina do not reach them and the resulting cessation of blood flow favors an accumulation of carbon dioxide and other breakdown products. Oxygen inhalation permits extension of the normal range of diffusion of oxygen to reach the avascular inner retinal layers. The enhanced diffusion across the retina aids the ischemic tissue only in its oxygenation; it does not supply other metabolites. In total permanent occlusion, experiments support the expectation that in spite of adequate oxygenation, the ischemic retina (lacking other metabolites) would ultimately degenerate.

Restitution of retinal blood flow is fundamental in the treatment of retinal occlusion. Fortunately, in many cases cessation of blood flow is either temporary or partial, as evidenced by a return of varying levels of vision following an occlusion. It is in these patients that oxygen inhalation therapy should be particularly beneficial, for it reduces the severity of anoxic damage during the temporary ischemia. Oxygen inhalation may therefore be considered as an adjunct to oxygenate the ischemic tissues until adequate circulation is restored.

In relatively recent occlusions, Patz recommends vigorous attempts to re-establish blood flow as an emergency procedure. Oxygen should be administered by a tightly fitting mask or nasal catheter at a flow rate of at least 8 liters per minute during the initial trial. Oxygen should be used in conjunction with one, or preferably with a combination of some of the following procedures; cervical sympathetic block, massage of the eyeball, paracentesis, retrobulbar block, and vasodilators.

If no appreciable change in visual acuity or in the visual field is noted after 30 minutes, oxygen should be discontinued. If improvement is noted, inhalation should be continued for a period of about 2 to 4 hours along with other measures to re-establish retinal circulation.

The responses to oxygen inhalation in 4 clinical cases are presented. In 2 cases of early occlusion oxygen had been administered, with an apparent beneficial effect, as an adjunct to routine therapy. In 2 other cases in which oxygen was not administered until 2 days after the occlusion, no effect was obtained.

—*Joshua Zuckerman, M.D.*

Fat Embolism of the Retina; Demonstrated by a Flat Retinal Preparation. THOMAS P. KEARNS. *Am. J. Ophth.*, 1956, 41: 1.

THERE APPEARS to be no question that fat embolism of the eye, just as of other tissues, may follow extensive trauma in which long bones are fractured. There does seem to be a question as to whether the retinopathy of ocular fat embolism and Purtscher's traumatic retinal angiopathy are the same. The purpose of the complete paper is not to prove or disprove that Purtscher's retinopathy and the retinopathy of fat embolism are the same. However, a case of systemic fat embolism due to trauma is presented in which retinopathy similar to Purtscher's traumatic retinal angiopathy appeared. The retinopathy was thought clinically to be the result of ocular fat embolism, and, at necropsy, fat embolism of the retina was demonstrated by a technique of flat retinal preparation.

Hemangiopericytoma of the Orbit. SIDNEY A. FOX. *Am. J. Ophth.*, 1955, 40: 786.

THE AUTHOR presents a case of hemangiopericytoma of the orbit. Of 54 cases appearing in the general medical literature, only 3 have been cited in which the ocular adnexa were affected. The pericyte (first described by Zimmerman in 1923) is believed to be a modified smooth muscle cell.

Grossly, hemangiopericytoma is not easily identifiable because it is not always red and it may lack other characteristics of vascular tumors. Hemangiopericytomas originate early in life, or even before birth, but may appear at any age after birth. They vary in size, are slow-growing, have a strong tendency to infiltrate surrounding structures, to recur, and even to metastasize occasionally.

Hemangiopericytoma was first described by Stout and Murray in 1942. It originates by proliferation of the contractile pericytes, cells with long processes which are found in the external capillary wall and which, although they have no myofibrils, are responsible for the changes in the caliber of the capillary lumen. Microscopically the lesion is made up of clumps of epithelial-lined tubes which may contain red blood cells. Endothelial sprouts without lumina are also seen. Both are enclosed in fibers of scanty reticulin around which are seen the rounded or spindle-shaped cells either in single layers or filling the spaces between vessels. A great deal of connective tissue may be present.

The tumor is easily differentiated from the hemangioendothelioma because the endothelium of the capillary is normal, and from the glomus tumor because it lacks the organoid structure of the latter.

The case reported by Fox occurred in a white woman 34 years of age. When she was 14 years of age she noticed a small yellowish growth on the conjunctiva near the right outer canthus. Two separate series of treatment with "radium needles" during the next 4 years failed to eradicate the growth.

At the age of 18 years, the tumor was resected and diagnosed as a xanthoma. It recurred at the age of 21 years and was again resected and diagnosed as benign vascular neurofibroma. At the age of 31 years it recurred, and was again resected and diagnosed as

a benign sclerosing hemangioma. The present recurrence, which was visible and palpable, had been noted for the past 2 months. When the orbit was entered at the outer canthus by a transconjunctival approach an amorphous yellowish mass was found. It was removed along with part of the sheath of the rectus muscle. Microscopic examination of the removed tissue yielded the diagnosis of hemangiopericytoma of the orbit. —*Joshua Zuckerman, M.D.*

NOSE AND SINUSES

Dermoid Cysts of the Nose; a Presentation of 7 Cases. HUGH CRAWFORD, CARTER MAGUIRE, NICHOLAS GEORGIADE, and KENNETH PICKRELL. *Plastic & Reconstr. Surg.*, 1955, 16: 237.

SEVEN CASES of dermoid cyst of the nose treated at the Duke University Hospital are reviewed, bringing the total number of reported cases in the American and British literature to 72. The authors believe this cystic anomaly frequently may be readily differentiated from other conditions occurring in this region, but occasionally gross and microscopic examination of the surgical specimen is necessary.

Several theories were quoted to explain the embryologic development of these anomalies. In all instances the fault stems from a minute amount of ectoderm being trapped in early fetal development. The theories differ in the manner in which the ectoderm is trapped.

In 5 of the 7 cases presented, the dermoid cysts were discovered between the age of 2 months and 7 years. There were 4 males and all the patients were white. None of the cysts presented malignant changes.

The successful treatment of a dermoid cyst, according to the authors, requires its complete removal or obliteration. Many of them are located in the subcutaneous tissue and require only simple excision; however, an occasional one requires considerable diligence on the part of the surgeon. The removal may be made easier in some cases by the injection of a dye through surface fistulas when they are present. An external approach was followed in all cases.

Some deformity may result because of a defect which the cyst has produced in adjacent structures. At a later time this can be corrected.

—*John J. Ballenger, M.D.*

MOUTH

Our Present-Day Surgery of Harelip (Unsere derzeitige Lippenspaltenchirurgie). H. GELBKE. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955. 282: 616.

AT PRESENT the technique for unilateral harelip used by the author is essentially that of le Mesurier, which is, in turn, a modification of the method of Hagedorn (FIG. 1). To this the author has added a supplemental technique for the correction of the nasal deformity.

In the supplemental technique a V-shaped incision is made—as shown by the discontinuous line in Figure 1—which exposes the alar cartilages. The cartilage on the affected side, which, as a rule, is flattened and widely spread, is freed with scissors from the skin of the outer side of the ala of the nose and stitched in place in a higher position, that is, to a point where the external meatus on the affected side is similar in

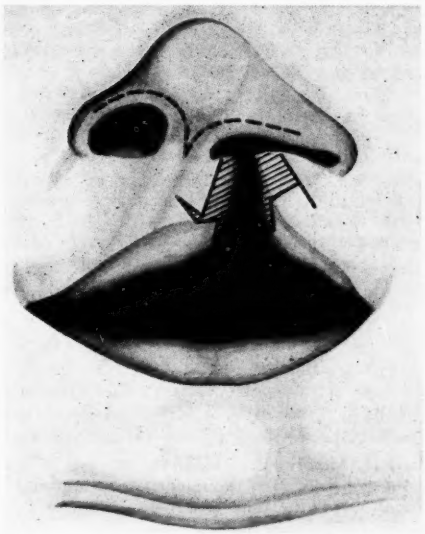


FIG. 1 (Gelbke).

size and form to that on the normal side. The V-shaped incision is then closed in the form of a "Y." This form of suture lengthens the anterior end of the nasal septum and raises the tip of the nose; it renders necessary the removal, in the sense of Burow, of more or less extensive triangles of skin at the outer ends of the V-shaped incision.

The rest of the operation then proceeds in the form of the author's modification of the le Mesurier technique, a technique which he described in detail last year (*Beitr. Klin. Chir.*, 1954, 188: 406).

In the treatment of bilateral harelip, particularly the severe forms with protrusion of the os incisivum, an attempt is first made to bring back this protruding bone more or less into line with the anterior edges of the maxillae. The author has taken this technique from the teachings of Denis Browne (*Ann. Roy. Coll. Surg.*, 1949, 5: 169). In this technique a wedge-shaped resection of the bone tissue is carried out between the vomer and the premaxilla (the prevomer bone of Denis Browne). The author tries to procure a fusion, at least on one side, between the freshened anterior edges of the maxillae and the freshened corners of the os incisivum. Browne attempted to get proper immobilization of the fragments and parts concerned by means of a metal plate with wire sutures. The plastic operation on the lip itself is carried out secondarily by holding as closely as possible to the technique described for the unilateral harelip closure.

A number of photographs in the original article show the excellent results procured by the author during the past couple of years; however, he states that his method will probably change with time and emphasizes the fact that the time elapsed after the operations is still too short to permit of an evaluation of the final results; for this evaluation he believes that not only 2 years, but 2 decennia, may be necessary.

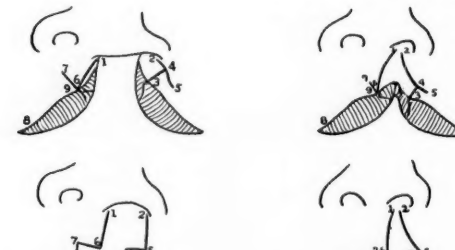


FIG. 1 (LeMesurier). To show the amount of downward rotation needed of the quadrilateral flap and the relation of this to the angle of the medial flap.

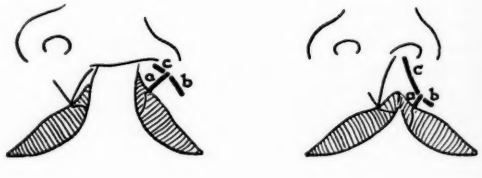


FIG. 2 (LeMesurier). Vertical height of the finished lip is about ⅛ inch less than the combined length of the wounds sutured vertically. The marks for these wounds—*a*, *b*, and *c*—should be made so that their lengths will add up to one-eighth inch more than the vertical height desired.

The author thinks that the improvement in the results obtained today in the surgical treatment of harelip is to be ascribed to the general progress in surgical methods (tracheal intubation anesthesia, better combating of shock, antibiotics) rather than to a tendency toward specialization on the subject. Of course, he does not disapprove of greater specialization; however, he believes that this specialization should represent an intensification rather than a narrowing of the field of our endeavors.

—John W. Brennan, M.D.

The Quadrilateral Mirault Flap Operation for Harelip. A. B. LEMESURIER. *Plastic & Reconstr. Surg.*, 1955, 16: 422.

THE AUTHOR describes in detail the use of the Mirault flap in the correction of harelip as practiced by himself. Only a general summary is possible here.

In almost any unilateral cleft, it is believed that the lip in the lower part should be made as wide as possible, without making it too short.

A second problem to be considered is the degree to which the quadrilateral flap should be rotated downward, and, combined with this and closely connected with it, the marking of the cuts on the medial side. The amount of downward rotation needed depends on the nature of the cleft (Fig. 1). In a complete cleft, the mucocutaneous border of the flap runs in an almost vertical direction and a considerable amount of downward rotation may be needed, sometimes nearly a right angle. In lesser clefts this border runs more nearly in a horizontal direction and less downward rotation is needed. The downward rotation is largely brought about and maintained by the flap from the medial side (1, 6, 7) that fits into the notch above the rotated flap, and in almost any type of cleft the angle at the peak of this medial flap should be about the same size as the rotation needed.

A third problem is how to get a lip of the proper height. This is done by adjusting the length of a, b, and c (Fig. 2). Their combined length should be ⅛ inch longer than the desired height of the lip. The author prefers to operate on children of 12 to 14 pounds; children of this size commonly require a lip ½ inch in height. A caliper is used to make the various measurements. Once again the reader is referred to the original article for a detailed description of the technique of the operation.

—John J. Ballenger, M.D.

Crescenteric Perialar Cheek Excision for Upper Lip Flap Advancement with a Short History of Upper Lip Repair. JEROME P. WEBSTER. *Plastic & Reconstr. Surg.*, 1955, 16: 434.

PERUSAL of the medical literature reveals that innumerable procedures have been devised for the repair of upper lip defects. If the lesions are small, immediate closure after excision can be made, although this curtain-like structure with its lower border hanging free is readily susceptible to distortion. Excision of larger lesions with immediate closure may produce tightness of the upper lip, with a discrepancy in the protrusion of the upper and lower lips, and possibly medial displacement of the commissures of the mouth. Replacement of the larger losses of substance has to be made from tissue brought in to fill the defects. In the majority of methods previously described, use is made of pedicle flaps from adjacent, neighboring, or distant parts with the blood supply intact. Free skin grafts have only recently been used to surface or line the lip, or a combination of pedicle flap and free grafts has been used.

Many of the principles of advancement of partial thickness or full thickness flaps have been utilized. The lip and cheek are ideal sites for the mobilization of flaps. The upper lip is attached only at its upper border and sides and lies free at its lower border. The cheek with its natural excess of elastic or stretchable tissue, composed of skin, fat, muscle, submucosa and mucosa, and with no ungiving fascial layer. is at-

tached only in a small percentage of its area to the underlying superior maxilla and mandible. When the cheek is freed from these attachments, additional advancement is made possible. It is natural, therefore, that in the great majority of procedures devised for the repair of upper lip defects, use is made of cheek tissue. The similarity of the cheek as donor material for the upper lip is great; both are of approximately the same thickness, consistency, and elasticity; both have a mucous membrane lining, and the skin of the cheek resembles that of the upper lip in color, vascularity, and often in hairiness.

The author reviews past methods which have been devised for the repair of defects of the upper lip, viz., those of Teale (of London), Kazanjian and Converse, Sedellot's modification of Malgaigue's method, Palatta, Ferris Smith, John Staige Davis, Gordon Buck, Cole, New and Figi, and others.

Usually, local anesthesia with infraorbital nerve block, possibly supplemented by mental nerve block, is used in the author's procedure.

If the lesion to be removed is small and superficial, eliptical excision through the skin and subcutaneous tissue of the lip may suffice. Simple closure of such a defect by undermining the surrounding tissue and approximating the wound edges might produce an upward turn of the vermilion border in a wolflike snarl, particularly if the lip is narrow, or the ala might be displaced downwards after such closure of the defect. Vertical wedge excision of the lesion through the entire thickness of the lip may prove to be more satisfactory. If this is deemed too radical for the excision of so superficial a lesion, replacement may be made by a flap of skin and subcutaneous tissue from around the ala and cheek. For this procedure, an incision in the alar fold is made and carried down to the defect. Another incision is then carried downward and outward from the defect to form a wedge-shaped flap which is undermined through subcutaneous tissue into the cheek. The excision of a crescentic piece of tissue from the cheek lateral to the ala will lengthen the upper skin edge of the flap. This is then brought forward to fill the defect with the under surface of the perialar flap securely anchored by subcutaneous sutures to the fibrous tissue of the ala.

If a pedicle flap lying lateral to the ala is to be used with its base directed downward and outward, a cheek flap can be swung downward and medially with closure of the cheek snugly about the ala. Such a flap may extend above the ala alongside the nose.

For larger defects comprising the full thickness of the upper lip, full thickness of the remnant of the lip and part of the cheek are used. The procedure can be carried out on one side or both sides of the nose. An incision is made in the alar fold down to the periosteum and may, if necessary, be carried upward above the ala alongside the nose. This incision follows the ala on the under side of the nose to the defect. The lip and cheek are then retracted upwards and the mucosa and submucosa are incised on the cheek side of the sulcus. The muscles are then stripped away from their attachment to the superior maxilla and this dissection is carried up to the infraorbital foramen.

This procedure allows the cheek to be brought in medially, and in this advanced position the mucous membrane and submucosa are closed with interrupted sutures. The flap is then drawn forward and tentatively held in position by hooks or traction sutures, or it may be temporarily held in position by sutures. A crescentic portion of perialar cheek tissue is then excised so that the skin edge of the cheek incision fits that of the ala without distortion. The cheek flap is anchored at the ala by heavy buried sutures either to the periosteum or to the fibrous tissue of the ala, so that the pull of the cheek will not displace the nostril. Closure of the lip is made by layered sutures with due attention to the formation of a lip of satisfactory length and protrusion, and with no discrepancy of skin junction at the vermilion border. If it is desired to replace the floor of the nostril, a point may be left on the cheek flap to fit into this defect.

If it is found, with trial suture of the flap in position, that the upper lip is too tight and that the lower lip protrudes with a possible narrowing of the mouth, the lip sutures may be cut and the defect closed by an Abbe flap from the lower lip rotated through 180 degrees. The bridge between the lips is severed at a secondary operation.

It may be deemed advisable in some cases to make use of a pedicle flap that borders the ala and that may extend along the side of the nose. In this event the flap is swung downwards to form the lip, and the cheek tissue is brought in snugly about the ala with closure in the natural alar fold.

Eleven cases are presented.

—John J. Ballenger, M.D.

Cancer of the Lip; with Special Reference to the Predisposing Influence of Sunlight and Other Climatic Factors. MARTTI JOHANNES HÄMÄLÄINEN. *Ann. chir. gyn. fenn.*, 1955, 44: supp. 6.

CARCINOMA of the lip has generally been regarded as due to exogenic irritants. Ever since the end of the eighteenth century, pipe-smoking in particular has been held to be important among these. Only recently have research workers also begun to stress the importance of sunlight and other climatic factors.

The principal aim of the present investigation has been to study the significance of the predisposing factors mentioned in the etiology of cancer of the lip on the basis of clinical material. According to Ayres (1923) sunlight and other climatic factors cause chronic cheilitis exfoliativa and cheilitis actinica. The author therefore carried out a statistical study, both clinically and histopathologically, of the incidence of this condition among patients in the present series, and to determine whether the development of cancer from it is demonstrable.

The investigation is based upon 125 cases of leukoplakia, 122 cases of chronic ulcer, 50 cases of cheilitis, and 810 cases of cancer of the lip treated or examined at the Central Institute of Radiotherapy, University of Helsinki, from 1936 to June 30, 1950. Certain cases of precancerosis were followed for a longer period, up to as late as 1954, since in these cases cancer was not diagnosed until later. The material further comprises a control group of 311 normal subjects consisting principally of persons referred to the Institute for roentgen examination, either healthy or suffering from some disease other than cancer.

Sunlight and other climatic factors cause exfoliation of the lips of persons hypersensitive to light. In the case histories attention was paid to the occurrence of such exfoliation. In 452 of the present cases of cancer of the lip, information on this point was available and exfoliation had occurred in 187 patients (41.4±2.3 per cent). The case histories of 218 patients with other lip diseases included in the present material—leukoplakia, chronic ulcer and cheilitis—revealed that 84 patients (38.5±3.3 per cent) had a history of exfoliation. Of 311 persons of the control group, 50 (16.1±2.1 per cent) had a history of exfoliation. The patients in the present material have thus had a significantly higher tendency to exfoliation of the lips caused by sunlight than normal subjects.

The symptoms begin usually in the spring when the reflection of light from the snow is intense, but also on sunny, dry, and windy summer days on the seashore and even inland. The dark season brings temporary relief and the disease sets in again the following spring. Blisters may occur on the lip and, when they burst, leave superficial wounds. They are followed by exfoliation and the lips become dry. The site of the disease is almost exclusively the lower lip. When actinic cheilitis persists for years, precancerous changes occur in the lip which may form the basis of cancer. It is believed that B-complex hypovitaminosis may be partly responsible for the development of actini cheilitis.

Histopathologic examination was performed on the lips of 218 (73.4 per cent) of the 297 patients in the group with leukoplakia, chronic ulcer, and cheilitis and on specimens from 728 (89.9 per cent) of the 810 patients in the cancer group. Histopathologic specimens from 54 patients with actinic cheilitis were particularly carefully examined, and also serial specimens from the same patient at different stages of the disease up to the appearance of cancer.

Histopathologic specimens from patients with actinic cheilitis revealed chronic inflammation. Common changes were thickening of the epithelium, acanthosis, and a tendency to proliferation. In the submucosa the inflammatory changes predominated. By means of routine histologic technique, histopathologic characteristics typical of actinic cheilitis could not be observed, neither was there anything that would allow of conclusions as to the effect of irradiation. A series of histopathologic specimens from the same patient showed that with the progress of the disease precancerous features appeared in the microscopic picture, such as epithelial proliferation, hyperkeratosis and parakeratosis, acanthosis, leukoplakia, an increased tendency to cell division, a tendency to deep infiltration, and finally carcinoma. Consequently actinic cheilitis should be considered a precancerous condition which may develop in a malignant direction. Since, however, leukoplakia and chronic ulcers from which cancer also develops occurred in patients with a negative history of exfoliation too, there are many other irritants besides actinic cheilitis which are of importance in the etiology of cancer of the lip. These irritants act simultaneously and thus the irritation produced by actinic cheilitis is mostly combined and with other irritations. However, the present material includes patients in whom no irritant other than actinic cheilitis could be demonstrated, these patients also being nonsmokers.

In patients with cancer of the lip who had had actinic cheilitis, cancer showed a tendency to develop at a younger age than in patients with a negative history of cheilitis. Of 184 patients who had had actinic cheilitis and whose age was known, cancer of the lip occurred in 24 who were less than 40 years old (13.0±2.5 per cent), while only 10 patients of the 188 cancer patients with a negative history of cheilitis (5.3±1.6 per cent) had cancer of the lip before the age of 40.

Patients suffering from actinic cheilitic cheilitis are more or less hypersensitive to light; thus the only effective treatment would be the avoidance of light. Administration of vitamins of the B complex had a favorable effect on the course of the disease even though the effect was in many cases of short duration. Efforts can also be made to alleviate the symptoms with protective salves, particularly if the patient is compelled to work in clear sunlight. Radium treatment of the lip carcinomas of patients with cheilitis has an unfavorable effect on the cheilitis. On the other hand, were such patients to be treated surgically alone, the operative scar would be susceptible to nutritional disturbances if severe cheilitis is present. Therefore radium treatment of patients with cheilitis does not seem contraindicated. There is no reason, however, to treat cheilitis alone with irradiation, since this only aggravates the condition.

Sixty five (8 per cent) of the patients in the present series ascribed their cancer to previous trauma; however, the trauma probably only aggravated existing cancerous tissue, while in other cases the tumor obviously developed in a scar of long duration. In 7 cases only (0.9 per cent) does it seem possible that the trauma together with other factors had a direct effect on the development of cancer.

Fifty four patients in the present series (6.7 per cent) had some other cancer besides cancer of the lip. Of the 239 deaths in the series, 31 (13 per cent) died from some cancer other than cancer of the lip (112 patients died from cancer of the lip). According to the mortality statistics of the Central Institute of Statistics, 6.11 per cent of corresponding age classes in a group of the same size in the general population died of similar cancers. Patients with cancer of the lip thus had a higher tendency to cancer in general than normal subjects.

The results of radium and other radiologic treatment have been reported as recovery rates, in conformity with Dorn (1951). $RR=\frac{A_o}{A+D+L}$, A being the number of patients alive at the end of the year, A_o being the number of patients alive with no evidence of cancer, D being the number of patients dead within the year and L, the number of patients untraced within the year. The results of treatment were as follows:

Patients primarily admitted for treatment: 5-year recovery rate, 55.4 per cent (net cure rate=78.4± 2,7 per cent). Patients without metastases: 5-year recovery rate, 65.5 per cent (net cure rate=93.3±1.8 per cent).

Previously surgically treated patients with local recurrence, with or without metastases: 5-year recovery rate, 43 per cent (net cure rate 58 ± 8 per cent).

Previously surgically treated patients without local recurrence, with or without metastases: 5-year recovery rate, 42 per cent (net cure rate 53 ± 8 per cent).

—John J. Ballenger, M.D.

Involvement of the Dental Pulp by Malignant Tumors of the Oral Cavity. EVERETT E. STEWART and EDWARD C. STAFNE. *Oral Surg.*, 1955, 8: 842.

CASE HISTORIES, roentgenograms, and surgical specimens from 39 patients with malignant tumors of the oral cavity were studied for the purpose of determining the incidence of tumor involvement of the dental pulps. The teeth, in some instances, were still incorporated in block sections of the mandible. They were decalcified, sectioned, and stained for microscopy.

The patients ranged in age from 16 to 75 years, the mean age being 50 years. Males predominated 4 to 1.

Ten distinct histopathologically differentiated types of malignant tumors were observed in this study, with tumors of the carcinoma type comprising nearly 85 per cent of the total. The primary lesions occurred most frequently on the lower lip, mucous membrane of the cheek, the mandible, and the maxillary antrum.

The average length of time from the appearance of the primary lesion to the date of the operation at which the teeth were collected was approximately 43 months. However, 44 per cent of the patients had histories of the presence of the primary lesion for less than 12 months.

In only one of these 39 malignant tumors of the oral cavity were tumor cells found involving the dental pulp. This positive finding was seen in the pulp of a mandibular right canine tooth of a 63-year-old white man with a squamous cell epithelioma, grade 1, primary in the mucous membrane of the right cheek. The tumor involved the dental pulp by direct extension through the mandible and perforation of the apical foramen for a distance of 2 millimeters into the root canal of the tooth.

It appears that the incidence of involvement of the dental pulp by malignant tumors of the oral cavity that are amenable to treatment and not in the terminal stages is low.

NECK

Thyroid Abscess. M. W. REECE. *Brit. J. Surg.*, 1955, 43: 218.

SUPPURATIVE THYROIDITIS is an uncommon disease which usually develops in a previously diseased gland, and is caused by any one of a wide variety of bacteria. The author's patient, a 67 year old woman, had had a goiter for 35 years before an abscess developed in the left lobe. The diagnosis was not difficult, and the abscess (an infected cyst containing pus and gas) was removed without difficulty. The latter was the basis for the unusual feature of this case, the appearance of a fluid level within the mass outlined on the roentgenogram. Inasmuch as the septic features of the illness were controlled by prior administration of penicillin, the organisms which produced the gas were suppressed. Only a nonhemolytic streptococcus was isolated from the specimen. No other means by which gas might reach the abscess were found.

—Leonard D. Rosenman. M.D.

The Effect of Propylthiouracil on the Biologic Decay Rate of I^{131} from the Thyroid Gland in Euthyroid and Hyperthyroid Subjects. HAKAN LINDERHOLM and IVAR WERNER. *Acta med. scand.*, 1955, 153: 103.

THE BIOLOGIC DECAY RATE of I^{131} from the thyroid gland was studied in 8 euthyroid and 8 hyperthyroid subjects before and during treatment with propylthiouracil. The thyroid uptake and urinary excretion of I^{131} were traced to check the diagnosis and the effect of treatment. In the hyperthyroid group, the 48-hour thyroid uptake and urinary excretion indicate thyroid hyperfunction. In the euthyroid group, not all the 48-hour uptake and excretion values clearly indicate euthyroidism.

In the hyperthyroid group, when treatment with propylthiouracil was administered a considerable decrease in the basal metabolic rate with improvement in the general condition was observed, but the biologic decay rate of I^{131} from the thyroid was not significantly affected. In the euthyroid group the biologic decay rate increased considerably after treatment with propylthiouracil. Some of the euthyroid patients suffering from congestive heart failure showed some peculiarities in the uptake of I^{131} but the effect of the propylthiouracil was not significantly different than in the others.

The effects of antithyroid drugs and the probable role of thyrotropic hormones in this connection are presented.

—Stephen A. Zieman, M.D.

The Vulnerability of the Recurrent Laryngeal Nerves at Thyroidectomy. J. S. H. WADE. *Brit. J. Surg.*, 1955, 43: 164.

AMONG the English surgeons the practice of routine dissection of the recurrent laryngeal nerves during operations for thyroidectomy is as much a matter for debate as it is in this country. The author lends strength to the argument favoring routine exposure of the nerves by illustrating significant anomalies and variations in the anatomy of the nerves. He is persuaded that had so-called blind technique been employed the

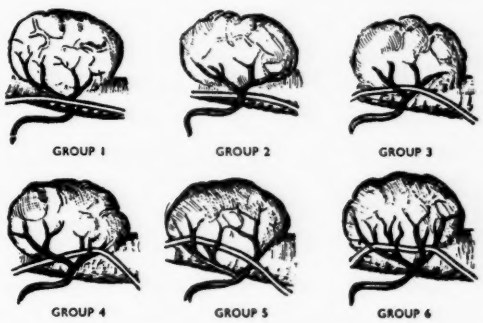
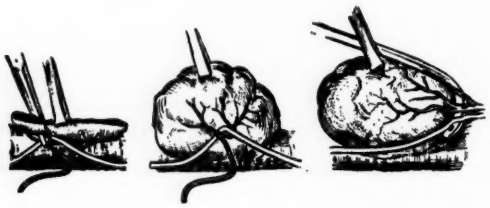


FIG. 1 (Wade). Diagrams illustrating six of the eight significant nerve-artery relationships.



a b c

FIG. 2. a, Damage to the recurrent laryngeal nerve at the superior pole of the goiter during hemostasis of the thyroid remnant. b, The recurrent laryngeal nerve rendered vulnerable at the midthyroid region by fixation to the goiter within the fork of the two main divisions of the inferior thyroid artery. c, Damage to the recurrent laryngeal nerve during ligation and division of the inferior thyroid veins.

nerves would have been particularly vulnerable to injury in 15 of 100 thyroidectomies. Furthermore, his careful dissections caused no injuries.

Exposure of the nerve in its upper third is more difficult because it is obscured by rather dense fascia. Injury in that region may occur when hemostasis in the thyroid remnant is attempted (Fig. 2a).

Variations of the relationship of the nerve to the inferior artery are reviewed and illustrated (Fig. 1). Fixation of the nerve by one or more branches of that artery causes angulation when the gland is displaced. In that way the nerve is made more vulnerable to injury than in any other (Fig. 2b). Ligations of branches of the inferior veins may damage the nerve (Fig. 2c). Anomalies of origin, branching, and coursing alongside the trachea are illustrated, as well as displacements by the goiters themselves.

Injury occurs more frequently by compression in ligatures or hemostats than by sharp division. Traction or simple exposure of the nerves rarely if ever injures the nerves. —*Leonard D. Rosenman, M. D.*

The Surgical Anatomy of the Recurrent Laryngeal Nerve. RUTH E. M. BOWDEN. *Brit. J. Surg.*, 1955, 43: 153.

THE AUTHOR reports his findings in 32 dissections to demonstrate the anatomy of the inferior laryngeal nerves, with particular reference to fascial and vascular relations. The paper is accompanied by 14 excellent figures which are commended to the interested reader.

More emphasis than that given by most anatomists is placed on the portions of the pretracheal fascia which enclose the thyroid and attach it to the trachea. The recurrent nerves and the terminal parts of the inferior thyroid arteries lie in flat compartments of the fascia between the posterior surfaces of the thyroid and the trachea and esophagus.

The nerves often ascend from the mediastinum more anteriorly than is usually described, sometimes along the mid-axis of the trachea. In most cases, this more exposed position is on the right side. There was little variability in the manner of entry of the nerves into the larynx.

More variation was observed regarding the relations of the nerve to the lateral condensations of fascia (lateral ligaments). Although displaced by a nodule in one gland, the nerves did not penetrate any of the thyroids in this group of dissections; the nerves were behind the inferior thyroid veins in all cases. The relation to the arteries was variable. The posterior position was more common, but in some cases the nerve ran in front of the arteries while in others it was found amid branches of the artery, which sometimes pulled the nerve awry. Variation was more common in the right.

Of great interest is the absence of bilateral symmetry of the nerve-artery relationship in two-thirds of the cases. Similar asymmetry is noted for extralaryngeal branches of the nerves to the larynx, which occurred in two-thirds of specimens. As many as six branches have been found (Rustad, 1954) to develop at or below the middle third of the glands.

Variations in the origins and divisions of the inferior artery occur more often in the left side, where total absence of the artery is a less unusual phenomena, than on the right.

An anomalous right inferior laryngeal nerve arising in the neck and passing anterior to the inferior thyroid artery was found in association with an anomalous right subclavian artery, which arose from the descending arch of the aorta.

The surgical implications of these anomalies and variations are apparent.

—*Leonard D. Rosenman, M.D.*

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Posttraumatic Epilepsy (L'epilessia post-traumatica). G. M. FASIANI and G. MORELLO. *Chirurgia*, Milano, 1954, 6: 421.

THIS ARTICLE is an excellent study of the pathogenesis and treatment of epilepsy following head injuries due to demonstrable pathology of the cerebral cortex.

When a meningocerebral cicatrix forms following a head injury, there is an abnormal mechanical fixation of the cerebral cortex. This fibrous scar may undergo retraction, which produces further deformity of the cerebral cortex. Under these conditions, the cortical circulation is also supplied by the extracerebral blood vessels with their sympathetic nerve supply and a further abnormal factor is thereby introduced. In the chronic phases, there is a gradual destruction of the corticocellular elements. Electroencephalographic studies have shown that the epileptogenic focus in such cases is in the region of the meningocerebral cicatrix.

The diagnosis of epilepsy can usually be made from the clinical history. The history of trauma must be carefully elicited to be sure that one is not confronted with a case of idiopathic epilepsy not related to trauma. Roentgenographs of the skull for traumatic deformities and, in particular, the pneumoencephalogram should be carefully evaluated for circumscribed atrophy of the cortex or the ventricles and for the presence of meningocerebral scars and adhesions which occlude and produce a "tent" deformity in the subarachnoid space. The electroencephalogram should be examined for the presence of "spike seizure" discharges. They are usually of short duration and increased amplitude.

Only those patients who do not respond to conservative medical management and have frequent and severe crises are considered candidates for surgery. In the latter cases, one must demonstrate a lesion roentgenologically or surgically. There should be an abnormal circumscribed focal electrical discharge. There should also be localizing signs from the seizure clinically to support the focal origin of the trigger area in the cerebral cortex. The pathology in these cases may vary. There can be a osteomeningocerebral cicatrix. There may be a meningocerebral cicatrix. There may also be a circumscribed atrophic or cystic formation of the cortex. Thickening and calcification of the arachnoid and abnormal vascularization may be seen on the cortex.

The principles of surgical correction are twofold. The defect should be removed and conditions should be made ready for a simpler scar which can be expected to undergo rapid resolution, more favorable than the scar previously removed. The operation is done under local anesthesia and a large bone flap exposure is done. Cortical electroencephalograms are then taken and the focus is outlined. If necessary, the cortex can be stimulated to reproduce the aura of the seizure. After this area is excised, electrical tracings are again taken until the foci of spike discharges are removed. Judgment should be exercised in resecting lesions of the motor cortex. When this is completed, special attention is given to repair of the dura. If excision was necessary, then a fascia lata transplant is made for a dural substitute. Skull defects are also repaired at this time.

The authors have used the above principles in 49 cases which have been followed up for at least 2 years. Fifty-six operations were done on these patients with no mortality. The results of these procedures are analyzed in nine graphs in the original article which can be referred to for further detail. In 55.1 per cent of the total, favorable results occurred; in 36.7 per cent there was no recurrence of seizure during the 2 year period of observation. As to the type of lesions observed at surgery, from 50 to 58.3 per cent showed the least variation in the results obtained. As to the location, the most favorable results were obtained in lesions located in the temporal lobes (75 per cent); and the least improvement was seen in lesions located in the occipital lobe (33 per cent). Of 20 cases followed up electroencephalographically after surgery, 10 gave normal tracings, 3 had persistent spike seizure discharges, and 7 had nonspecific abnormal records.

—*Roland A. Manfredi, M.D.*

SPINAL CORD AND ITS COVERINGS

Anatomic and Radiologic Studies of the Intervertebral Canals in the Cervical Spine (Anatomische und roentgenologische Studien ueber die Intervertebralkanaele der Halswirbelsaeule). A. PICHLER. *Fortsch. Roentgenstrahl.*, 1955, 83: 638.

THE AUTHOR discusses at some length the relatively complex anatomy of the intervertebral foramina of the cervical spine. These, he believes, should be considered not as simple openings but rather as canals, whose contours may be extremely varied and irregular. The exact relations of the spinal nerves and ganglia to these canals cannot be shown in life but can be demonstrated in the cadaver. However, for a better visualization of the involved area he presents a new technique of positioning the patient in relation to the film and x-ray tube. Very slight variations, as little as 5 degrees tilt of the x-ray tube in a dorsoventral or craniocaudal direction, are shown to very markedly alter the appearance of the canals. Distortion due to divergence of the x-ray beams must also be considered. Because of these various factors a very careful and critical approach is necessary in the evaluation of changes seen on films of the cervical spine even with optimal radiologic technique.

—*Nicholas Wetzel, M.D.*

The Early Diagnosis of Compression of the Spinal Cord by Neoplasms. G. F. ROWBOTHAM. *Lancet*, Lond., 1955, 2: 1220.

THE AUTHOR reviews and analyzes 80 cases of compression of the spinal cord by neoplasms encountered

in the years 1941 to 1948. There were 60 primary and 20 secondary lesions. Forty-six of the tumors were extramedullary neoplasms including 14 meningiomas and 22 neuromas. These two tumor types as a group frequently produced symptoms of segmental pain or pain deep in or near the midline at the location of the tumor. When pain was nonsegmental, rigidity of the spine and restricted movement with tenderness were noted. The sensory loss in the segmental distribution of the pain was often incomplete. Weakness in the extremities frequently developed many months after the onset of pain. By the time paralysis was first noted, the cerebrospinal fluid protein usually demonstrated elevation, and a level of 60 milligrams per cent was significant. The author emphasizes the need for repeated, closely-spaced lumbar puncture and manometric studies. Radiographic abnormalities were often late in appearance.

A small group of patients demonstrated weakness in the extremities unassociated with pain, sensory or sphincter disturbance. The differential diagnosis of a parasagittal meningioma is again emphasized.

Angiomas of the spinal cord may be clinically indistinguishable from the group just discussed. They rarely give increases in cerebrospinal fluid protein and rarely a block for manometric study. The author believes operative treatment has little to offer.

Tumors of the cauda equina produce findings of sciatic pain, sphincter disturbance, weakness, and sensory loss, and lumbar fluid and manometric studies may be deceptively normal if the needle is placed above the lesion. Blood through a needle introduced directly into the tumor and the association of spina bifida with an underlying embryoma are noted.

In the case of intramedullary spinal neoplasm, the author found the clinical picture indistinguishable from syringomyelia, and believed that operative treatment was of no value.

Primary tumors arising from bone and cartilage of the spinal column produced severe back pain and radiologic findings of changes in the vertebra. At the first sign of cord compression, decompression was considered desirable in those cases which were nonresectable.

The 20 cases of secondary neoplasms included tumors from the bronchus, prostate, breast, kidney, and stomach. Erosion demonstrable in the radiologic studies was noted in 12 of these. The author points out the crushing mechanism of these tumors and also the strangulating effect upon the blood supply of the cord, which mechanism may account for the underlying neural changes and the rare efficacy of decompression and removal of the tumor. Operative correction is recommended to relieve pain. The rapid development of the paralysis in the secondary cases is striking, whereas in the benign lesions, paralysis develops more deliberately over months and years. The need for early assessment of such cases before a damaging and severe paralysis occurs is re-emphasized.

—*W. Eugene Stern, M.D.*

Late Laminectomy in Traumatic Paraplegia. LARS HAGELSTAM. *Acta chir. scand.*, 1955, 110: 218.

FORTY-EIGHT PATIENTS with spinal injury and cord involvement (26 with closed injury, 22 with open war-type injury) were treated surgically by laminectomy, the injuries being located throughout the various spinal segments, and being operated upon variously from one month to ten years after injury. The author believes that definite neurologic improvement was obtained in 5 of the patients with open injury, and in 10 of those with closed injury. At operation he found the usual conditions: retained bullet, bone splinters, dense extradural scars, laminal compression, and anterior ridging due to vertebral body displacement.

Since there is an increasing incidence of paraplegic patients who do continue to live under the conditions of improved rehabilitative techniques, and since a very worthwhile number of such patients can receive at least minimal—sometimes considerable—improvement by even delayed laminectomy (granting that early laminectomy offers much greater rewards), the author is a strong advocate of offering whatever help may be available to this group of patients, who certainly have little to lose in any event by such surgery. He believes that even though no actual physical improvement results from the surgery, the psychologic effects on the patient are beneficial, for the patient will then realize that the possibility of improvement has been thoroughly explored, that the "other fellow" hasn't been given a better chance than he, and that he will more willingly and earnestly devote himself to his rehabilitative schedule. The author's courageous and optimistic viewpoint is to be commended. He quotes many American surgeons in support of his ideas. However, his opinions will not be shared by a large segment of both American and British neurosurgeons.

—*John Martin, M.D.*

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Primary Tumors of the Rib. N. R. BARRETT. *Brit. J. Surg.*, 1955, 43: 113.

A GENERAL DISCUSSION is given of the clinical and pathologic aspects of primary tumors of the ribs as seen by the author in 50 cases during the past 20 years. There were 19 patients with cartilaginous tumors, 14 with fibrous dysplasia, 6 with osteochondroma, 3 with lipoid granuloma, and 1 patient with osteoclastoma and a solitary myeloma.

Many of these tumors will first be picked up by mass x-ray examination. The cartilaginous tumor is the most common type of primary rib tumor and it is found in both sexes and in patients of all ages. The presence of a tumor mass is usually the first symptom. Grossly these tumors are of a pearly grey, and occasionally cystic spaces develop, but malignancy can be determined only by microscopic study. Contrary to general opinion these tumors do not arise in the cartilage but in the rib. Treatment consists of wide excision of the tumor together with the intercostal structure, since local recurrence is common. Should the lesion be malignant, the ultimate prognosis is poor. Fibrous dysplasia might be suspected from the x-ray picture of the regular areas of calcification and a "soap bubble" appearance. Unless the surgeon has had much experience with lesions of this nature, a correct diagnosis requires biopsy and/or excision. Other rib lesions, some of which are not true tumors, are rare. —*Roger D. Williams, M.D.*

The Management of Metastatic Mammary Cancer. OLOF H. PEARSON, MIN C. LI, JOHN P. MACLEAN, MORTIMER B. LIPSETT, and CHARLES D. WEST. *J. Am. M. Ass.*, 1955, 159: 1701.

PALLIATIVE MEASURES used in the control of metastatic mammary cancer are outlined. Endocrine therapy, whether by ablation or hormone administration, has the advantage over roentgentherapy that its effects, when they are favorable, are not confined to the area treated.

Present-day endocrine therapy includes the use of androgens, estrogens, and cortisone, as well as oophorectomy, adrenalectomy, and hypophysectomy. The indications for each of these forms of treatment are given with a review of the palliative results obtained. Theories of the mechanism of action of the therapeutic agents are presented. No practical or accurate means of predicting which patients will benefit from operation exists; however, patients who improve following oophorectomy are also likely to obtain a remission with adrenalectomy.

A recommended sequence of therapy for metastatic breast cancer is given. Oophorectomy is suggested as the first method of treatment in premenopausal patients. The form of further therapy for these women depends on whether the cancer is endocrine-dependent or not, as determined by the response to oophorectomy. The first recommended palliative measure for postmenopausal women is combined oophorectomy and adrenalectomy; further measures are governed by the response to this form of treatment.

The author's recommended sequence of therapy is controversial and cannot be fully substantiated by present results in relatively small groups of patients.
—*Harvey W. Baker, M.D.*

Endocrine Treatment of Metastatic Breast Cancer. O. H. PEARSON, C. D. WEST, J. P. MCLEAN, M. C. LI, and M. B. LIPSETT. *Am. Surgeon*, 1955, 21: 1075.

SEVENTY-FIVE premenopausal women with metastatic breast cancer were subjected to oophorectomy. Forty-four per cent of these patients obtained objective remissions of their disease for an average duration of 9 months. Worth-while palliation was produced in those who had a favorable response. Approximately 50 per cent of patients have estrogen-dependent tumors, and oophorectomy removes a major source of estrogen and gives temporary improvement. Oophorectomy is the treatment of choice in premenopausal women with metastatic breast cancer. Neither the histologic nor the chemical picture has been helpful in predicting favorable responses.

Among 38 women with metastatic breast cancer, all of whom had had oophorectomy previously, adrenalectomy was done with objective remissions in 45 per cent. The average duration of the remission was 8.5 months. Adrenalectomy succeeds by removing another source of endogenous estrogen. Thus, only patients with estrogen-dependent mammary cancer are benefited by adrenalectomy. Failure to respond to oophorectomy would screen out unsuitable candidates for adrenalectomy. In postmenopausal women, combined oophorectomy and adrenalectomy is the recommended initial method of therapy for metastatic breast cancer.

Hypophysectomy produces profound suppression of the function of the ovaries and adrenal glands, which is comparable to the surgical ablation of these endocrine organs. Further experience with this procedure is needed before a final appraisal of its value in advanced breast cancer can be made.

Treatment with androgen is helpful in only 20 per cent of the cases and its action is not known. It also can accelerate the growth of mammary cancer. Its use should be reserved for patients who cannot tolerate, or who refuse, ablative therapy. It is also indicated in patients who have had relapse after oophorectomy and adrenalectomy.

Estrogen has produced regression of metastatic breast cancer in 32 per cent of postmenopausal patients. It should be used cautiously as it can accelerate growth in some cases; if it does it should be withdrawn at once.

Cortisone has produced short remissions in some metastatic breast cancers and the authors believe that its use should be reserved for patients who fail to respond to other types of therapy.
—*Edmund R. Donoghue, M.D.*

Total Adrenalectomy and Oophorectomy for Carcinoma of the Breast. KATHLEEN CUNINGHAM. *Med. J. Australia*, 1955, 42: 1021.

TOTAL ADRENALECTOMY and oophorectomy will give relief from pain and offer a 40 per cent chance of arresting the spread of disease for a limited but undetermined period of time. This operation was performed on 30 patients. Oophorectomy as well as adrenalectomy must be done because of the ovarian factor which is reactivated by removal of the adrenal glands.

All histologic types of breast carcinoma will respond favorably to adrenalectomy. Improvement in nutrition and relief from pain is rapid and regression of metastases is noted early. Osteolytic lesions either recalcify or progression ceases. Death occurs from irreversible adrenal failure rather than from carcinoma. Palliation can not be obtained by cortisone therapy. Failures of adrenalectomy are due to accessory adrenal tissue (32 per cent) usually around the celiac plexus, or to breast carcinoma which is not influenced by either the ovarian or adrenal hormones. On the day prior to operation 300 to 350 milligrams of cortisone is given and then it is reduced slowly until a maintenance dosage of 37.5 to 50 milligrams per day is obtained. Bilateral adrenalectomy should not be done in one stage. The first operation consists of bilateral oophorectomy and left adrenalectomy; the other adrenal is removed within 2 weeks.

In this series, one death occurred because of the perforation of an undiagnosed peptic ulcer.

—*B. G. P. Shafiroff, M.D.*

TRACHEA, LUNG, AND PLEURA

Traumatic Rupture of the Bronchus. WILLIAM G. ECKMAN, JR., BERNARD N. ROSENBERG, and E. B. GALL. *Ann. Surg.*, 1956, 143: 98.

HISTORICALLY, traumatic rupture of the bronchus was first described in 1912. Since that time, 50 cases have been recorded in the medical literature with 29 recoveries. The authors report a case in which traumatic rupture of the bronchus had produced complete right main stem bronchus obstruction and subsequent atelectasis of that lung. The patient was successfully treated by the bronchial reconstruction procedure of Gebauer, which entails the use of a dermal graft made rigid but malleable by interwoven wire, and which is sutured into place in the bronchial defect.

The most common immediate effect of rupture of the bronchus is pneumothorax. Massive collapse, mediastinal emphysema, and hemothorax may also be present. If the patient survives the acute phase, the bronchus heals by fibrosis, and stricture formation is the usual sequela. If the bronchus is only partially occluded, the end result is pulmonary suppuration. If occlusion is complete, there is loss of function without suppuration, together with over-expansion of the contralateral lung.

Early after injury, a massive air leak from the chest should alert the surgeon to consider rupture of the bronchus. Later, with the history of injury plus either pulmonary suppuration or complete atelectasis, the diagnosis can best be confirmed and the involved area localized by bronchoscopy.

The treatment in the acute phase consists of relief of tension pneumothorax or mediastinal emphysema, the former by tube thoracotomy, the latter by suprasternal mediastinotomy. If a massive air leak persists, good expansion of the lung is not achieved, or intrathoracic hemorrhage is excessive, thoracotomy should be performed. If rupture of the bronchus is found, simple closure is usually all that is necessary and the results should be excellent since fibrosis is averted.

The treatment in the late phase is dependent on whether the bronchus is completely or incompletely occluded. If incompletely occluded, infection and suppuration have usually occurred by the time the patient is seen, necessitating pneumonectomy or lobectomy. Bronchial dilatation is generally unsatisfactory. In complete occlusion, however, the atelectatic lung is potentially expansible and free from infection. The procedure of choice in such a case should be reconstruction of the bronchus by the simplest method available: excision of the occluded area with primary anastomosis, or reconstruction of the defect with some material. One of the most satisfactory methods is that described by Gebauer, utilizing a dermis graft reinforced with wire, as was used in the case reported, with complete re-expansion of an atelectatic lung and restoration of normal pulmonary function.

—*Arthur M. Simpson, M.D.*

A Contribution to the Surgical Treatment of Chronic Pneumonia (Ein Beitrag zur chirurgischen Behandlung der chronischen Pneumonie). R. BERCHTOLD. *Helvet. chir. acta*, 1955, 22: 299.

THE AUTHOR reports the case of a man 54 years of age who had suffered for several months from cough, chest pain, hemoptysis, and episodes of fever. Although bronchoscopy and biopsy showed no evidence of carcinoma, a thoracotomy was performed and the right upper lobe of the lung was removed. The histologic examination revealed chronic interstitial and xanthomatous pneumonia. The patient made an uneventful recovery.

The author states that the clinical as well as the roentgenological findings frequently do not permit differentiation between this type of chronic pneumonia and bronchial carcinoma. For patients who do not respond to medical treatment, surgery is the treatment of choice. —*Werner M. Solmitz, M.D.*

Resection in Bilateral Pulmonary Tuberculosis (Zur Resektionsbehandlung bei doppelseitiger Lungentuberkulose). R. ZENKER. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955, 282: 509.

BILATERAL PULMONARY TUBERCULOSIS which does not respond to conservative treatment presents numerous problems in operative therapy. The author in a series of 230 resections for pulmonary tuberculosis, had 17 cases of bilateral involvement in need of more active treatment. In all cases some form of collapse therapy had been performed in greater or lesser degree, unilateral or bilateral, which increased the difficulties in the planning of the operation. In these cases the decrease in the respiratory capacity is always to be respected and the resection has to be as conservative as possible. Complete postoperative expansion of the lung is necessary and obtained by division of adhe-

sions, decortication, and continuous suction in order to avoid a postoperative atelectasis. Restoration of the function of the diaphragm is obtained through respiratory exercises. Segmental resection was preferred over lobectomies.

In deciding the extent of the resection, the side where the resection is to be performed, as well as the size of the tuberculous process and the respiratory reserve, is of importance as the removal of the right upper lobe causes relatively little loss of respiratory function as compared with removal of the left upper lobe where the two segments of the lingula and the anterior segment should be preserved.

In 13 of the 17 cases no complication occurred and the respiratory function was only slightly decreased as compared with the preoperative studies. The causes of death and complication in the other cases are described.

The author wishes to emphasize that in bilateral pulmonary tuberculosis segmental resection offers good results in 80 per cent of the cases, and the results would improve in every case of bilateral involvement if segmental resection were given preference to collapse therapy from the beginning of treatment. It would also avoid the development of resistance to streptomycin. —*Hellmut Mattheis, M.D.*

Simultaneous Bilateral Resection for Pulmonary Tuberculosis in Mental Patients. F. JOHN LEWIS, NORMAN E. SHUMWAY, MANSUR TAUFIC, BARNEY ZIMMERMAN, and Others. *J. Thorac. Surg.*, 1956, 31: 93.

RESECTION OF BILATERAL PULMONARY LESIONS is performed through a transverse incision at the level of the third interspace in mental patients. The pectoralis muscles are split and the interspace is opened bilaterally before the sternum is split. The respiration is usually controlled with a single lumen tube; a double lumen tube is rarely necessary. A self-retaining retractor is placed in the midline. In segmental resections the arteries are first sectioned; then the bronchus and veins are ligated as encountered. Each cavity is drained by large intercostal catheters. The sternum is closed with heavy stainless steel.

This operation was done on 16 patients with no mortality. The most common operation was an apical posterior segmental resection. In 3 patients, the sternal portion of the wound broke down. Tracheotomy was a necessary adjuvant in sustaining wound healing of the chest. The causation of sternal wound breakdown in mental patients may be due to strenuous movement while the patients are in the agitated state. Reactivation of tuberculosis has not as yet occurred in the fifteenth month postoperative study period.

—*B. G. P. Shafiroff, M.D.*

Difficulties in Differential Diagnosis of Benign and Malignant Tumors and Chronic Intrathoracic Granuloma (Des difficultés du diagnostic differentiel entre tumeurs bénignes et malignes et granulomes chroniques intrathoraciques). P. DESAIVE. *Acta chir belg.*, 1955 Supp 2, 43.

THE ETIOLOGIC DIAGNOSIS of constructive inflammatory or tumoral lesions of the mediastinum and pleuropulmonary regions may present peculiar difficulties, since they are usually discovered at routine x-ray examination, present few symptoms, and those far from specific. Thoracotomy may yield information of aid in making therapeutic conclusions. An annual international conference dealing with errors in judgment in this field, and their consequences, might yield great help in this problem.

In the present study, the benign tumors and chronic granulomas of the chest were accompanied by few symptoms and showed a lack of specificity in x-ray findings. The cases are grouped topographically, and include 5 tumors in the superolateral mediastinum with direct or indirect involvement of the thyroid, 2 tumors in the inferomediastinal region, 2 in the hilar regions, 2 in the apical region, 4 in the lateral thoracic wall, 1 in the diaphragmatic region, and 3 in the pulmonary parenchyma. In several instances comparisons are made with the findings in a simulating malignant lesion.

The mistaken diagnoses in the first 5 cases of tumors in the superolateral mediastinum included: (1) a descending goiter—for adenoma with colloid vesicles attached to the thyroid by a thin pedicle; (2) a benign or malignant posterior mediastinal thyroid tumor, or a possible mediastinal metastasis from a microscopic intralobar cervical thyroid epithelioma—for a benign colloid adenoma of the thyroid with cystic degenerative areas and foci of chronic inflammation; (3) neurinoma for posterior intrathoracic goiter; (4) the diagnosis of a right intrathoracic goiter, glandular metastasis from breast cancer, or a ganglioneuroma—in a case of adult ganglioneuroma of fibrous consistency and adult type; (5) diagnosis of an intrathoracic thyroid lesion, invasive thymoma, or granuloma of unknown nature—in a case of apparently old, chronic, nonspecific inflammation.

In the cases of tumors involving the inferior lateral mediastinum, the diagnosis in one case was that of a neurogenic tumor, the specimen revealing a sympathetic ganglioneuroma, and in the other case a probable pleuropericardial cyst instead of the histologically confirmed fibrous cyst with serous contents and marked superficial lymphoplasmocyte infiltration.

The mistaken diagnoses in tumors of the hilar region were: (1) right mediastinal teratoma—for malignant lymphogranulomatosis (Hodgkin's type) infiltrating the pulmonary parenchyma and wall of the vena cava superior; (2) left mediastinolateral embryoma—for a cystic hamartoma. The former of these two cases, besides indicating that Hodgkin's disease may be of frankly mediastinal origin, revealed the abnormal pulmonary and venous infiltrating nature of this granuloma from the start. In the apical region, the wrong diagnoses included (1) thymoma, ganglioneuroma, or hamartoma—for ulcerofibrocaseous tuberculosis, (2) probable sarcoma developing from a nerve lesion in a woman with von Recklinghausen's neurofibromatosis—for a fusiform sarcoma with fibrous and myxomatous areas; (3) probably benign intrapulmonary tumor of mixed connective tissue—for a bronchial epidermoid epithelioma. In one of these cases a fatal diagnosis was followed by recovery, and in the third case the lack of clinical symptoms and the sudden fatal outcome due to cerebral metastasis illustrate the extraordinary polymorphism of evolution of lung cancers.

In the cases involving the lateral thoracic wall, the condition was wrongly diagnosed as (1) influenzal pleuropneumonia—for malignant mesothelioma; (2) Ewing's sarcoma—for myeloplasmocytoma; (3) ordinary pachypleurisy, benign or malignant mesothelioma, pleural fibrosarcoma, cavernous hemangioma of the pleura, or invasive costal tumors—for recurring fibroma or desmoma developing under endocrine influence as a benign but invasive tumor. Attention is drawn to the pleural repercussion of very large adjacent tumors of pleural, costal subpleural, and intercostal or external parietal origin. In one case of tumor in the diaphragmatic region the tumor was wrongly diagnosed as a probable primary massive tumor of the right hemithorax and diaphragm—instead of a fibrolipomyxoma with xanthomatous and osteoid plaques. The absence of osteopathic lesions in this case was attributed to excellent adaptation of the heart and left lung to loss of function in the right lung, or to the independence of the vascular system in relation to the tumor as it concerned the pulmonary return circulation.

Incorrect diagnoses in tumors of the lung parenchyma involved difficulties encountered in the correct diagnosis of bronchiolar carcinoma. Only histologic examination will frequently permit distinction between hamartoma and cancer, and in one case such examination rendered it possible to distinguish between nonspecific chronic pneumonia and bronchial epithelioma. The treatment indicated, in the absence of certain diagnosis, must be left to the experience and judgment of the surgeon. It is to be hoped that publication of an increasing number of cases of difficult diagnosis will lead to the discovery of more signs or characteristics of these various conditions so that eventually it may be possible to determine the operative indications beforehand and make the reasonable sacrifice of tissues justifiable.

The article is accompanied by four roentgenographic illustrations. —*Edith Schanche Moore*

Pulmonary Ventilation During Open Thoracotomy; Inflation and Deflation Time Ratios and Pressures. Thomas F. Nealon, Jr., George J. Haupt, Joyce E. Price, and John H. Gibbon, Jr. *J. Thorac. Surg.*, 1955, 30: 665.

The value of intermittent positive and negative pressure ventilation during open thoracotomy is again emphasized by this detailed study of 20 patients maintained on the Jefferson ventilator throughout their surgical procedures. This ventilator is a compact positive and negative pressure apparatus which is easily attached to the anesthesia machine; instantaneous conversion from automatic to manually controlled respiration is available if the occasion arises. The study consisted of arterial blood pH and carbon dioxide determinations, the analysis of carbon dioxide in the inspired and expired gases by means of the Liston-Becker infrared absorption carbon dioxide analyzer, and measurements of endotracheal pressure and ventilatory volume. The ventilatory rate was constant, 20 per minute, while three ratios of inspiration to expiration were evaluated—1 to 2, 1 to 1, and 2 to 1.

Normal expansion of the lungs during open thoracotomy was achieved with a mean endotracheal pressure of 4 to 6 cm. of water. At pressures of 7 cm. of water, or greater, surgical exposure of the pulmonary hilus was obscured by the distended, almost incompressible lung. Pressures of 5 cm. of water permitted both normal pulmonary excursions and easy retractability for maximal exposure. In the presence of severe emphysema the mean endotracheal pressure was lowered to 1 cm. of water to prevent overexpansion of the lungs. Negative pressure was particularly important in promoting deflation of emphysematous lungs.

The most efficacious ratio of inspiration to expiration from the standpoint of pulmonary ventilation was 1 to 1. The volume of air moved through the lungs was proportional to the pressure difference between inflation and deflation. Greater volumes could be accommodated at lower mean endotracheal pressures through the use of negative pressure during expiration. Normal or reduced levels of arterial carbon dioxide pressure in all except 2 cases of open thoracotomy were attributed to intermittent positive and negative pressure ventilation.

—*Norman E. Shumway, M.D.*

HEART AND PERICARDIUM

De-Epicardialization; a Simple, Effective Surgical Treatment for Angina Pectoris. Dwight E. Harken, Harrison Black, James F. Dickson, and Hugh E. Wilson, III. *Circulation*, 1955, 12: 955.

Methods of treating coronary insufficiency and angina pectoris, particularly surgical methods, are briefly reviewed. The work of Burchell, who repeated many of the techniques directed at the production of vascular adhesions, is particularly noted, for he found that the epicardium constituted a barrier that prevented the penetration of vascular channels of substantial size. The lead acetate-agar injection mass of Schlesinger which will enter only vessels 40 micra or larger in diameter did not enter the vessels produced by any of the techniques tested by Burchell. The present work prompted the investigation of methods of removing this epicardial barrier.

While it is possible to remove the dog's epicardium by mechanical stripping, it was believed that this procedure was too time-consuming for use in humans with coronary insufficiency. A variety of substances were used in attempts to destroy the epicardium. The most ideal substance found for this procedure was 95 per cent phenol. In a series of 31 dogs, after opening the pericardium the surface of the left ventricle was painted with a single application of 95 per cent phenol on a cotton swab. This resulted routinely in a graying of the epicardial surface. No alcohol was used to neutralize the phenol. In 20 of these animals, gelfoam sponges were placed over the phenolized area and the pericardium was loosely closed, while in 11 animals one of the adjacent lobes of the lung was pulled in beneath the pericardium and sutured in this position. The results following these two slightly different modifications were essentially the same. Attempts to occlude the anterior descending coronary artery by cellophane wrapping failed so that the ingrowth of vessels which was found may be considered to have occurred in the absence of any ischemic stimulus. The anastomoses with the coronary tree which were pro-

duced were large enough to carry the Schlesinger mass. No evidence of phenol toxicity was found in any of the animals.

Following this, the operation was applied to a selected group of 18 patients who were suffering from angina pectoris. However, in addition to the phenol application to the epicardium and the suturing of a part of the lingula of the lung inside the pericardial sac, powdered asbestos or talc was also blown into the pericardial sac. All patients in this group were relieved of their angina immediately following surgery. Two patients died within 2 months following surgery as a result of fresh coronary occlusions; however, all cases were too recent to draw any conclusions regarding revascularization. It is unfortunate that the authors' criterion of success in these patients was the relief of their angina, for this is known to follow the insufflation of talc alone. —*David T. Petty, M.D.*

Mitral Insufficiency; Experimental Circular Suture Around the Atrioventricular Ring. JOHN BORRIE. *J. Thorac. Surg.*, 1955, 30: 687.

THE PROBLEM of correcting regurgitation in mitral valvular defects caused by anatomic deficiency of the cusp or dilatation of the valvular ring has been approached in several ways, viz., tamponade of the orifice from below, narrowing of the valve orifice by sewing the chordae tendinae with purse string sutures, and by invaginating the auricular appendage through the valve to tamponade from above.

The author proposes to correct this type of defect by narrowing the mitral orifice with a purse string suture, as has been done in dogs to produce mitral stenosis. He reports his experience with this method in normal sheep. A circular suture of floss-silk is placed around the left arioventricular fibrous ring and drawn tight. This procedure would re-establish the normal form and function of a dilated ring. Experimentally, it was found that the suture should be placed above the left coronary artery and passed into the interventricular septum at the inferior interventricular groove to traverse the heart. No cardiac irregularity arose from this procedure as it produced narrowing and thickening of the atrioventricular ring, which nevertheless allowed normal functioning of the mitral valve cusps and chordae tendinae. After a period of 2 to 3 months, it was found that in several animals the diameter of the ring had been reduced to half its normal. —*David T. Petty, M.D.*

Clinical Observations Before and After Mitral Valvuloplasty; Physical, Radiologic, and Electrocardiographic Changes. JOHN F. OTTO, JR., J. MORRISON HUTCHESON, JR., WALTER H. ABELMANN, DWIGHT E. HARKEN, and Others. *N. England J. M.*, 1955, 253: 995.

IT IS THE INTENTION here to clarify some of the seeming discrepancies among symptomatic and objective manifestations of mitral stenosis and the changes that occur following surgical correction of the stenosis. One hundred six patients operated upon by Harken were examined 1 to 4.5 years after their operations. The degree of symptomatic improvement indicated that the results in this group did not differ from those obtained in a larger number (440), whose cases have been reported; 56 per cent were markedly improved, 21 per cent were moderately improved, 20 per cent had slight improvement, and 3 per cent were unchanged, in terms of tolerance for exertion, orthopnea, paroxysmal dyspnea, pulmonary edema, cough, hemoptysis, palpitation, chest pain, embolic accidents, and manifestations of heart failure. The symptomatic improvement may be measured by changes in requirements for dietary restriction, diuretics, and digitalis. In general, a gain of weight (not edema) and a rise of systolic and pulse pressures parallel the improvement.

Operative changes of the valve structure cause diminutions in the intensity of the mitral diastolic murmurs, but rarely do the murmurs disappear, and the early changes in those murmurs do not reflect the prognosis. Before operation, the presence of loud apical systolic murmurs usually denotes a significant degree of mitral regurgitation, and a poor prognosis for benefit from valvuloplasty. Grade 1 and 2 murmurs are present almost equally in patients with and without significant regurgitation. In those cases other criteria for regurgitation must support the diagnosis. The changes in the systolic murmurs after operation do not correlate well with the residual valvular defects, or with the degree of functional impairment. The development of a systolic murmur after operation has of itself no prognostic significance. Thirty-seven per cent of these patients had soft parasternal diastolic murmurs, thought to be caused by functional pulmonary insufficiency; those murmurs had no clinical or prognostic correlative significance. One half the number of patients with the parasternal diastolic murmurs had soft basal systolic murmurs, most of which became less intense after operation.

Nearly all of the patients with stenosis without insufficiency have had loud first mitral heart sounds. In about one-eighth of such cases the sound became normal after operation, and in the majority of that small group function was greatly improved. About one-half had some improvement of the first heart sound, usually accompanying clinical improvement, and occurring gradually over a period of several months. Changes in intensity of the pulmonic second sound, the loudness of which reflects the state of pulmonary hypertension, occur slowly in about one-third of the cases.

Significant roentgenologic changes in heart size seldom follow operations, and are not parallel with clinical improvement. When the roentgenologic evidences of postoperative changes in size of the right ventricle and the main and peripheral pulmonary vessels are grouped with the data pertaining to heart size, a very loose correlation of improvement in clinical status is noted. Those patients with mitral calcification, significant regurgitation, wide mitral apertures at the times of operation, fibrillations, and who are over 40 years of age tend to fall into the group whose roentgenologic data after surgery show deterioration. Furthermore, the roentgenologic demonstration of heavy calcification of the mitral valve gives a poor prognosis; mitral insufficiency is frequently present in that group.

Electrocardiographic findings are significant Whereas there is little difference in the number of patients with atrial fibrillation before and after opera-

tion, the presence of that abnormality carries a poorer prognosis for improvement after surgery. A shift of the electric axis of the heart toward normal correlates well with clinical improvement, as does lowering of the high P waves which signify right ventricular hypertrophy. Patients with sinus rhythm usually have a decrease toward normal of prolonged PR intervals. There is no correlation of the findings of incomplete right bundle branch block with those of right ventricular hypertrophy, and the former has no prognostic significance; in the latter instance, patients usually show remarkable improvement after operation. Electrocardiographic evidence of left ventricular enlargement appears after surgery in a few patients, in most of whom clinical improvement is lacking.

—Leonard D. Rosenman, M.D.

Successful Removal of a Myxoma from the Left Atrium. J. Gordon Scannell, William R. Brewster, Jr., and Edward F. Bland. *N. England J. M.*, 1956, 254: 601.

The successful surgical removal of a myxoma from the cavity of the left atrium under hypothermia is reported.

The presenting clinical picture was characteristic of a high degree of mitral stenosis, an important feature inasmuch as more primary tumors within the cardiac chambers will be found as the number of intracardiac operations increases. Although a preoperative diagnosis may be made through a high index of suspicion and angiocardiography, most of the diagnoses will be made at the time of operation. Under these circumstances, it is advisable to postpone removal of the tumor until it can be done under direct vision with temporary interruption of the circulation. Hypothermia currently appears to be the most convenient method of achieving this end, but total cardiac by-pass with pump oxygenator may well be the future method of choice.

A 33 year old man entered the hospital with intermittent dyspnea, wheezing, cough, and hemoptysis of 18 months' duration. He had previously been well and active all his life with no history of rheumatic fever. Physical examination revealed classic findings of a high degree of mitral stenosis without mitral regurgitation or congestive failure. X-ray studies were corroboratory and an electrocardiogram exhibited patterns of right ventricular and left atrial hypertrophy.

At the time of the first operation the atrium was found to contain a soft lemon-sized mass attached by a narrow pedicle to the base of the interatrial septum close to the posteromedial commissure of the mitral valve. Although part of the tumor had prolapsed into the valve orifice, thereby effectively interfering with the blood flow through that structure with some minimal regurgitation, the valve itself was normal. Removal was postponed in view of the disastrous results of earlier impromptu attempts to remove such tumors. The patient's postoperative course was uneventful.

Three weeks later, under pentothal, curare, and hypothermia, a second operation was carried out with a transsternal anterolateral approach. The great vessels were identified and isolated. Both internal carotid arteries were occluded by serrefine clamps, a Crafoord clamp was placed across the inferior vena cava, the superior vena cava was occluded by traction on a previously placed tape, the aorta and pulmonary artery were cross-clamped with a Crafoord clamp, and the atrium was opened by extension of the atrial incision. The edges of the atrial incision were retracted, and the narrow stalk of the somewhat lobulated tumor was separated by finger dissection from the atrial septum; the tumor was then delivered through the incision by means of a modified prostatic lobe forceps. No residual tumor could be identified. The total time of the circulatory occlusion was 5.5 minutes.

Ventricular fibrillation occurred immediately upon removal of the tumor. At this time the body temperature was 26.4 degrees C. (75.5 degrees F.). Manual compression sustained recordable peripheral pulse pressures of 60/40. Repeated attempts at cardiac resuscitation through electric defibrillation and epinephrine and calcium chloride injections were unsuccessful until after local organ rewarming with warm saline solution (40 degrees C., 104 degrees F.) and a general body temperature rise to 27.5 degrees C. (81.5 degrees F.). Normal sinus rhythm was restored 2 hours after the onset of fibrillation.

The postoperative and convalescent courses were remarkably benign. The patient resumed his work as a steel construction worker 5 months after the time of operation. The pathologic report of the tumor was myxoma, presumably benign.

—LeBaron W. Dennis, M.D.

Aortic Gumma Simulating Mediastinal Tumor; Report of a Case. Hilkka Heikkilä. *Ann. chir. gyn. fenn.*, 1955, 44: 203.

The case of a 46-year-old female luetic patient with a 13 to 16 months' history of substernal pain, shortness of breath, vertigo on effort, tiredness, cough, and hoarseness is reported.

The clinical diagnosis was tertiary syphilis and aneurysm of the aorta, but the possibility of a mediastinal tumor was considered. Tomography of the left lung revealed a nonhomogeneous shadow, approximately the size of an egg, above the left hilus. The patient had paresis of the left recurrent laryngeal nerve and positive serologic tests for syphilis.

Exploratory thoracotomy established that the arch of the aorta was enlarged with an attached 6 by 6 centimeter flat, knotty, greyish tumor, and a biopsy was taken. Histologic features of the tumor were typical of gumma. Postoperatively the patient recovered uneventfully and she was sent for treatment of her syphilis.

The author stated that aortic gumma, which always occurs in connection with aortic aneurysms, causes the disappearance of the elasticity of the vessel wall when it bulges under the influence of blood pressure. The occurrence of small gummas in the wall of an aneurysm is probably not very rare, but there are relatively few reported cases of a macroscopic aortic gumma.

A brief review of mediastinal tumors was given with particular emphasis on gummatous masses of the aortic arch.

—Gilbert S. Campbell, M.D.

Contraindications to the Surgical Therapy of Coarctation of the Aorta. WARD D. O'SULLIVAN and FRANK GLENN. *Ann. Surg.*, 1955, 142: 909.

THE SURGICAL TREATMENT of coarctation of the aorta is on a sound basis. It is associated with a shortened life span. The operation introduced by Crafoord and Gross has been performed in many clinics with good results and with an acceptable mortality rate.

The contraindications include: (1) life expectancy of normal length without operation; (2) aortic lesions not suitable for operative correction, (3) serious coexisting disease; (4) unsuitable age. The authors review these contraindications and illustrate them with cases from The New York Hospital, Cornell Medical Center.

Life expectancy of normal length without operation. The decision is difficult to make and should not be made in a young person. In the fully mature adult this expectation may be considered, but only if the blood pressure proximal to the coarctation is normal or near normal, if there is good pulse pressure in the lower extremities, and if there is no evidence of collateral circulation.

Aortic lesions not suitable for operative correction. Secondary degenerative or aneurysmal changes should be considered increased indications for resection. Long strictured segments should be similarly considered. In both instances homologous grafts should be used. A coarctation may be so proximal in the aortic arch that its removal may be impossible. This decision is best made at the operating table. Unusually placed coarctations demand individual consideration and individual treatment. Homologous grafts or an arterial by-pass may resolve the problem, or the problem may be insoluble.

Serious coexisting disease includes advanced pulmonary, renal, or cardiac disease.

Unsuitable age. In the very young, attention must be given to future growth of the aorta in general and of the aorta at the suture line in particular. Experimental work demonstrates satisfactorily that normal growth will take place at a line of aortic suture if certain technical details are carefully observed. Ideally, the operation is best performed after the age of 8 years. However, should the child's condition show any deterioration, prompt operation is indicated regardless of age. The authors have set no upper age limit for operation but a person in his forties presents an increased risk, a more difficult operation, and a lesser likelihood of reversion to normality. As a general rule, the ideal age should be less than 30 to 35 years. Above this, the indications must be strong.

—*Robert Paradny, M.D.*

Direct Vision Intracardiac Surgery by Means of a Reservoir of "Arterialized Venous" Blood; Description of a Simple Method and Report of the First Clinical Case. HERBERT E. WARDEN, RAYMOND C. READ, RICHARD A. DEWALL, JOSEPH B. AUST, and Others. *J. Thorac. Surg.*, 1955, 30: 649.

DURING THEIR EXPERIENCE with 40 intracardiac procedures under controlled cross circulation, the authors were impressed by the feasibility of low flow rates and by the relatively short period of cardiopulmonary bypass needed for most intracardiac operations. The donor was removed from his tubular anastomoses with the patient and became an oxygenator whose arterial blood was collected in a reservoir. Arterial blood from the donor was replaced with an equal volume of citrated, banked blood. Five hundred cubic centimeter siliconized bottles containing 16 milligrams of heparin and 50 cubic centimeters of 5 per cent glucose in distilled water comprised the manifold reservoir from which a simple finger pump propelled oxygenated blood into the patient. Venous blood in equal amount was extracted from the cavae of the patient to maintain hemobalance; 3,500 to 4,000 cubic centimeters of arterial blood was obtained in this way over a period of one hour with transfusion reaction essentially the only donor risk.

Blood with arterial chemical characteristics was preserved at room temperature for several hours without significant deterioration and for several days, if refrigerated. Citrated blood was found to be toxic to the myocardium, acid in *p*H, and could not be used for perfusion.

Even less hazardous for the donor was the adoption of a reservoir contributed to by a number of individuals each donating 500 cubic centimeters of "arterialized venous" blood. Immersion of the arm in water at 45 degrees C. for 15 to 20 minutes opens sufficient arteriovenous shunts to impart arterial characteristics to venous blood drawn from the antecubital fossa. All collections were effected by gravity to minimize red cell trauma. Blood was collected from the various donors on the morning of the day of surgery, transferred to a water bath at body temperature, then employed for the by-pass. This technique of "arterialized venous" blood was used successfully in 5 patients undergoing intracardiac surgery. The problem of time limitation due to reservoir depletion was not encountered.

—*Norman E. Shumway, M.D.*

The Arterialization of Blood as it Applies to the Mechanical Heart-Lung Apparatus. F. D. DODRILL, ALFRED LUI, JAN NYBOER, E. V. RIPPINGILLE, and C. H. HUGHES. *J. Thorac. Surg.*, 1955, 30: 658.

THE AUTHORS describe their experimental results with an artificial lung or "arterializer" for total cardiopulmonary by-pass in association with their previously documented mechanical heart. The oxygenator is essentially of the gas dispersion type whose bubbles of blood and oxygen are forced to coalescence by means of Dow-Corning antifoam. Arterial oxygen is introduced into the apparatus through a stainless steel filter, each pore of which is 10 microns in diameter. Blood is layered on oxygen emerging through the porous plate forming bubbles which swirl into the coalescing chamber. From the collecting reservoir arterialized blood is then pumped through a bubble trap into the systemic artery of the dog.

Oxygen saturation, carbon dioxide levels, and *p*H values remain well within normal limits during 30-minute periods of total heart-lung by-pass. Two per cent carbon dioxide and 98 per cent oxygen is the most suitable gas mixture for the oxygenator because excessive amounts of carbon dioxide are removed when pure oxygen is used. Platelet counts are diminished by 50 per cent after 30 minutes of by-pass, but the plasma hemoglobin seldom exceeds 100 to 150 mgm. per cent. Arterial pressures of 110 to 120 mm.

Hg. are maintained throughout the run; however, perfusion rates are not given.

The vena cavae are cannulated, the azygos vein is ligated, and all venous blood is pumped by the right ventricular component of the artificial heart into the arterializer. The left ventricular equivalent of the pump then returns the oxygenated blood to the arterial system. Bubbles are not seen in oxygenated blood leaving the arterializer, but any escape of bubbles is frustrated by passage through a flowmeter and bubble trap before discharge into the animal.

Total by-pass of the heart and lungs for 30 minutes with right ventriculotomy is successful in 75 per cent of dogs submitted to the technique. Human trial is not reported. —*Norman E. Shumway, M.D.*

ESOPHAGUS AND MEDIASTINUM

Spontaneous Rupture of the Esophagus; Report of a Case Cured by Conservative Treatment. IVAR R. SANDBERG. *Acta chir. scand.*, 1955, 110: 202.

THE AUTHOR questions the correctness of the term "spontaneous perforation" and in this view is supported by two other authors. It is generally thought that pressure has developed in the esophagus prior to the rupture and this pressure usually is associated with vomiting. Instances have been reported in which the esophagus has perforated during heavy lifting activity, with defecation, and with epileptic seizures. However, rupture has commonly occurred in acute poliomyelitis, hyperparathyroidism, and after craniotomy for cerebral tumors, and thus the purely mechanical etiology of the perforation must be held in doubt.

All spontaneous ruptures are localized to the distal portion of the esophagus, usually just above the diaphragm, and are nearly always longitudinal. The actual rupture is usually from 2 to 6 cm. long and is located in the posterolateral wall, so that the perforation occurs into the mediastinum or the pleural cavity, generally on the left side. Perforation and contamination of the abdominal cavity has been reported in only one instance.

The initial symptoms are typical, with vomiting attended by severe pain high in the epigastrium or behind the sternum, sometimes radiating towards the left shoulder or the region of the kidneys. The pain is immediately followed by shock, and breathing becomes painful. Cyanosis may set in gradually and a rapidly rising fever is to be expected after an initial subnormal temperature. Usually, the upper abdomen is quite rigid and the lower abdomen is soft. Subcutaneous emphysema can often be palpated over the upper part of the sternum, about the clavicles, and in the nuchal region after a few hours.

The chest plate usually shows mediastinal emphysema and perhaps effusion on the left side of the chest. Some authors use a small amount of contrast medium, preferably iodized oil, to cinch the diagnosis and to locate the perforation.

The differential diagnosis is chiefly concerned with perforated gastroduodenal ulcer, cardiac infarction, and spontaneous pneumothorax.

The generally accepted view seems to be that immediate surgical intervention affords the only chance of survival. Treatment of the shock is followed by left thoracotomy and suture of the esophageal rupture. The pleural cavity is cleared of foreign matter and then drained, preferably by water suction apparatus. Antibiotics should be administered immediately, both in the pleural cavity and systemically.

A case report is given in which severe pain developed in the left side of the chest with symptoms and signs of shock, after prodromal symptoms and signs for 12 hours previously. Immediate roentgenograms of the chest showed streaky densities in the lower left half of the lung and a small amount of fluid in the left chest. No subcutaneous emphysema could be detected either at the clinical examination or in x-ray films. The electrocardiogram was normal. Treatment of shock was instituted immediately and several hours later the patient was better from this standpoint but with a rising pulse rate and increasing dyspnea. Another x-ray was taken and this showed a greatly increased amount of fluid in the left thorax and a bulging of the mediastinum to the right in the lower portion of the chest. Thirteen hundred cubic centimeters of bluish-gray fluid was aspirated from the chest and streptomycin was introduced into the pleural cavity before removing the needle. Another aspiration was carried out the following day, and 4 days later and in each case penicillin and streptomycin were introduced into the chest after the aspiration. The pleural effusion gradually became purulent, cultures grew out pneumococci and gram-negative rods, and resistance tests showed susceptibility to streptomycin, chloromycetin, and neomycin. On the eleventh day of hospitalization the condition again became worse, dyspnea increased, and a chest plate showed another accumulation of fluid in the left pleural space. Thoracotomy and drainage was performed the same day with the recovery of approximately 750 cubic centimeters of purulent fluid. No adhesions could be palpated in the pleural cavity. On the sixteenth day the patient was given a solution containing methylene blue to drink and after a few minutes the colored liquid ran out through the drainage tube in the thoracotomy opening. During all this time he had been fed by means of a gastric tube which was passed on the evening of his first hospital day. After this his recovery was normal and subsequent visits disclosed no evidence of dysfunction of the esophagus or of his pulmonary system. —*Matthew H. Evoy, M.D.*

On the Surgical Treatment of Idiopathic Megaesophagus, in Particular on the Value of the Heller Operation; Considerations and Results (Sul trattamento chirurgico del megaesofago idiopatico, in particolare con la operazione di Heller; Considerazioni e risultati). E. DE CESARE and G. RICCI. *Ann. ital. chir.*, 1955, 32: 669.

THIS LONG DISSERTATION on idiopathic megaesophagus (cardiospasm) is divided into two sections. In the first, the authors set forth at great length the historical background of the recognition, study, and treatment of this condition dating back to Willis (1674) and followed chronologically to the present time. The second part is devoted to a detailed presentation of 15 patients all treated by Heller's operation.

The 15 patients from whom the authors accumulated detailed data are presented individually with

interesting roentgenograms. Of the group studied, 9 were males and 6 were females. The average age of the former was 50 years, and of the latter 30 years. The length of history varied from 2 to 25 years, the average being between 4 and 5 years. None of the patients showed any external signs of ill health or debility. There was no history of loss of weight, the chief complaint being dysphagia predominantly of solid food. A final diagnosis was made following x-ray examination. In some of the patients an esophagoscopy was also performed.

Carcinoma of the esophagus was diagnosed in 2 of the patients after the barium meal, but on subsequent re-examination the roentgenograms revealed cardiospasm. The authors suggest that in instances in which the x-ray examination furnishes a diagnosis of carcinoma, but the history and physical examination do not concur with this finding, a repeat x-ray examination is essential. Esophagoscopy may also yield a correct diagnosis.

All of the patients were first treated medically, but with little success. Some of them underwent dilatation with mercury bougies, which produced temporary improvement only. Subsequently, the Heller operation was performed on all 15 patients. This was done through an abdominal approach. The region of the cardiac sphincter was exposed, and the muscle fibers were divided and split longitudinally for 9 cm., approximately 4 cm. on the stomach side and 4 cm. on the esophageal side of the cardia. There were no postoperative complications. All of the patients showed excellent results, and some of them have been followed up for more than 5 years and found to be without recurrence of symptoms.

—Peter Beaconsfield, M.D.

A Case of Multiple Leiomyomas of the Esophagus. H. Max Schiebel and H. DeHaven Cleaver. *Am. Surgeon*, 1955, 21: 1133.

The present report deals with the successful removal of multiple (3) leiomyomas of the esophagus in a negro. The problem of diagnosing intramural tumors of the esophagus is discussed.

Benign tumors of the esophagus are about 1 per cent as common as carcinomas of the esophagus. Less than 200 definitely proved cases have been recorded in the entire world literature. In 75 of these the tumor consisted of a solid intramural mass (leiomyoma), usually in the form of a solitary lesion. Up until recently these tumors have not been properly recognized or treated. At first they were discovered only at autopsy, and one-third of the patients with polypoid tumors and one-sixth of those with solid intramural tumors died as a direct or indirect result of their lesions. At the time the authors operated upon their patient, only 35 leiomyomas and 30 other benign tumors of the esophagus had been removed surgically. With an increased index of suspicion and with the aid of modern radiology, esophagoscopy, and especially negligible-risk thoracotomy, these lesions should be discovered early and resected. The patient's general condition then is good, there is a good chance for complete resection, and less possibility of malignant degeneration; thus, the patient is relieved of his symptoms sooner and a permanent cure is achieved.

Patients from 19 months to 66 years of age have been successfully operated upon for benign tumors of the esophagus; males outnumber females; the majority of leiomyomas occur at about 40 years of age. In the case reported by the authors, the patient was a 31-year-old man. The authors note that only one other case of leiomyoma of the esophagus in a negro person has been found. This was especially interesting since leiomyoma of the uterus is so common in this race. Multiple tumors occur in less than 25 per cent of the reported cases of leiomyoma. The authors' patient had three separate nodules. In spite of this multiplicity he had no dysphagia or other localizing symptoms. Dysphagia occurred in about one-half of the cases of surgically removed leiomyomas and in one-third of all cases reported.

Although symptoms tend to be vague, a careful study of such lesions should lead to an early diagnosis. Frequently the lesion can be demonstrated preoperatively by careful radiologic examination. Esophagoscopy, physical examination, and laboratory studies are of secondary value in the consideration of solid intramural tumors. Easily accessible polypoid lesions often may be diagnosed and treated by esophagoscopy. Permanent cure requires early thoracotomy in most instances. The entire lesion should be resected. Examination of a frozen section should be made to rule out malignancy, in which case more radical surgery may be indicated. The risk is slight and significant complications are rare.

—Edmund R. Donoghue, M.D.

MISCELLANEOUS

Funnel Chest; Report of a Series of 100 Cases. Russell Howard. *Med. J. Australia*, 1955, 42: 1092.

Funnel chest according to the accepted concept is due to a congenital shortening of the central tendon of the diaphragm which causes a deformity at the sternoxiphisternal junction. This theory is challenged by the author because the diaphragm appears normal at operation. He also notes that funnel chest and pigeon breast are not uncommon occurrences in males of the same family on an hereditary basis.

Funnel chest is characterized by approximation of the lower sternum to the vertebral column and backward curving of the rib cartilages. In some cases there may also be erosion of the costal margins with groove formation. The third to eighth cartilages are involved. The deformity may vary from a mild flattening of the chest to near approximation of the sternum and the vertebral column. Cough, recurrent colds, and asthmaticlike attacks are common respiratory complaints. The vital pulmonary capacity is reduced and response to effort is limited. The heart is affected by compression between the sternum and the vertebral column as in constrictive pericarditis. Psychological effects develop and increase with age. Lateral tomograms give accurate values of the shortening of sternovertebral distance.

Operation is indicated in all cases in which reduction of vital capacity, cardiac displacement, or effort syndrome is proved. In 20 per cent of the cases, deformity is not sufficiently marked to warrant operation. Surgical intervention is recommended after the age of

FIG. 1 (Löhr, Soder). The mortality in blunt thorax injuries with contusion pneumonia.

four. A transverse incision is made at the level of the sternoxiphisternal junction, extending through the nipple lines. An upper musculocutaneous flap of the pectoral muscles and a lower musculocutaneous flap of the rectus muscles are raised. The substernal ligament is divided. The involved costal cartilages are resected subperichondrially and the xiphisternum is separated from the sternum. The diaphragm is freed from any attachment to the costal cartilages. A cuneiform osteotomy of the anterior table of the sternum is performed at the level of the highest cartilage and the sternum is fixed in an over-corrected position by osteotomy sutures.

A total of 42 operations of this type have been completed. The operative risk is negligible. A blood loss of 8 to 10 ounces is common in this operation and should be replaced. Ambulation is begun on the second postoperative day. Rehabilitation consisted of breathing exercises and posture correction.

—B. G. P. Shafiroff, M.D.

The Contusion Syndrome and Late Functional Disturbances After Blunt Injuries of the Thorax (Ueber das Kontusionssyndrom und die funktionellen Spaetschaeden nach stumpfen Thoraxtraumen). BERTHOLD LÖHR and ERICH SODER. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955, 281: 10.

THE AUTHORS, of the Surgical Department of the University of Heidelberg, Germany, discuss the so-called "contusion pneumonia" which is observed in about 60 per cent of all blunt thorax injuries. They base their observations on a material of 493 patients with blunt thorax injuries who were treated at the University Hospital during a period of 20 years.

Although the clinical symptoms, fever, chest pain, and dyspnea, are the same as in pneumonia, the x-ray findings are always negative and the "pneumonia" does not respond to antibiotic therapy, but in most cases it clears up with and without therapy in about a week. Therefore, the author suggests that the term "pneumonia" be avoided and that the condition be called "contusion syndrome."

Several graphs are presented to show different factors which influence the incidence and severity of the contusion syndrome: the incidence grows in proportion with the intensity of the trauma, especially when the injury causes rib fractures. Furthermore, the incidence and the mortality increase with higher age, and, finally, the general state of nutrition and health seems to be a decisive factor, the mortality of "contusion pneumonia" being more than doubled during the hunger years of the war and early postwar period as compared with the prewar and later postwar years (FIG. 1).

Late sequelae of "contusion pneumonia" could never be confirmed although claims for compensation by patients were frequent. Exact examinations, including residual air determination, spirometry, and bronchial spirometry, always permitted ruling out a connection between the injury and the complaint presented.

—Werner M. Solmitz, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Mesenteric Vascular Occlusion. B. O. ODEN and S. WALLENSTEN. *Acta chir. scand.*, 1955, 110: 177.

THE MATERIAL for this study was provided by reports of cases admitted to the Surgical Service of Serafimerlasarettet Medical School over a period of twenty years. Eleven cases of mesenteric vascular occlusion (8 males and 3 females) were studied, and only cases in which the diagnoses were verified at operation or at autopsy were considered.

The cause of vascular occlusion in the mesentery varies according to whether arteries or veins are involved. Arterial emboli occur most commonly in subjects suffering from cardiac disorders, particularly atrial flutter, and are believed to be brought about by thrombi on the valves or in the auricle of the left atrium. Venous emboli do not appear to occur. Arterial thrombosis is a common finding and this, in the majority of cases, is secondary to an embolus. Primary arterial thrombosis does occur rarely. Venous thrombosis in the mesenteric vessels is usually due to inflammatory conditions in the abdomen, such as appendicitis, pelvic peritonitis, or ulcerating carcinoma of the large bowel. Blood disorders such as splenic anemia and polycythemia are also believed to cause mesenteric thrombosis. Portal stasis precipitated by a tumor may result in thrombosis of the portal vein and later of the mesenteric vein. Injury to the abdomen may also cause thrombosis of the mesenteric vessels.

There is always difficulty in distinguishing at operation between arterial and venous occlusion. Even histologic examination of a resected specimen may be inconclusive as to the primary site of the vascular obstruction.

Mesenteric vascular occlusion is marked by an acute onset of abdominal pain which may be either a continuous ache or intermittent. After a few hours this intense pain changes to a more continuous dull ache. In the early stages the stools are frequently loose, and occasionally blood-stained. This latter symptom or sign occurred in only one of the 11 cases. Vomiting was a rather late sign. Usually after a few hours in which the patient is in relatively good condition, a state of shock develops quite rapidly.

A plain x-ray film of the abdomen in 6 cases showed in each instance signs of obstructive distention of loops of the small intestine with occasional gas in the ascending colon and part of the transverse colon. This gas-containing bowel is, of course, that portion of the intestinal tract supplied by the superior mesenteric vessel.

The authors conclude that intermittent abdominal pain and diarrhea combined with appearances suggestive of intestinal obstruction in a plain x-ray film, in a patient of advanced age with a history of cardiac disorder and arrhythmia, should lead one to consider a diagnosis of mesenteric vascular occlusion.

In each instance in which only laparotomy was performed and the diagnosis verified, the patient died. It is extremely important that the viability of the remaining intestine after resection is beyond doubt.

The involved portion of intestine was resected in 6 of their cases and 3 of these patients recovered. The length of intestine resected in these cases was 75, 100, and 200 centimeters, respectively. The maximum time that had elapsed in the surviving cases was twelve hours. —*Matthew H. Evoy, M.D.*

GASTROINTESTINAL TRACT

Plasmacytoma of the Gastrointestinal Tract. JAMES W. MERRITT, JR. *Ann. Surg.*, 1955, 142: 881.

TWO CASES of plasmacytoma of the gastrointestinal tract are presented, which brings the total number of reported cases to 19. This condition occurs in many different areas of the body and most commonly in the conjunctiva and upper air passages. Extramedullary plasmacytoma is a relatively rare tumor. Males predominate over the females about two to one. There is no clear correlation between the bone marrow studies, Bence-Jones protein, serum globulin levels, and the presence of gastrointestinal plasmacytoma. It is difficult or impossible to determine the prognosis from the histologic appearance of the tumor. The possibility of multicentric origin of these tumors is borne out by the simultaneous occurrence of plasmacytoma in two different areas in one of the cases reported by the author. —*John E. Karabin, M.D.*

Diverticula of the Stomach (A propos des diverticules gastriques). P. HILLEMAND, J. PATEL, and J. LATASTE. *Presse méd.*, 1955, 63: 1808.

THE PATIENT, a 44 year old native of Poland, had complained for more than 20 years of vague dyspeptic troubles. There was a bad taste in the mouth and a light burning sensation rising from the epigastrium toward the throat. For the past year this condition had become exaggerated and was accompanied by acid eructations which became more persistent with the taking of cold drinks and with the assumption of certain body postures, in particular with the bending forward of the trunk. For the past several months the patient has been troubled by alimentary vomiting.

The roentgenologic examination disclosed a constant rounded shadow, sharply delimited and attached to the lesser curvature of the stomach by a broad pedicle. With compression the mucosal folds of the stomach could be seen to pass into the barium-filled pocket. The lesser curvature was perfectly supple in the region of the pedicle. The gastroscope was unable to demonstrate the opening into the diverticulum.

At operation the diverticulum was found prolonged into the lesser omentum, with borders and walls perfectly supple. The pouch was removed by means of a segmental resection of the stomach.

Histologic examination of the removed specimen disclosed a mucosal lining of the diverticulum which in part reproduced the characteristics of the gastric fundus, and in part presented the appearance of an

intestinelike metaplasia. The walls showed evidence of the presence of a banal inflammatory process. The musculature was essentially normal. There was no indication of a malignant condition.

Recovery was uneventful, the patient leaving the service after a convalescent period of 2 weeks.

The authors believe that the etiology of this diverticulum can best be envisioned as a pulsion process of acquired nature and favored by the mural weakness incident to the entry into the stomach walls of the large vascular branches passing through the lesser omentum to the lesser curvature of the stomach.

—*John W. Brennan, M.D.*

Infantile Pyloric Stenosis. J. W. GERRARD, J. A. H. WATERHOUSE, and D. G. MAURICE. *Arch. Dis. Childh.*, Lond., 1955, 30: 493.

CAREFUL MEASUREMENT of the external dimensions of the hypertrophied pylorus was done on 51 patients subjected to operation for hypertrophic pyloric stenosis. A valid correlation between the size of the tumor and the age of the patient was established, the larger tumors being found in the older infants. The tumor size was not correlated with the weight of the patient.

To investigate environmental factors influencing the rate of development of symptoms, the histories of 152 infants with the disease were reviewed. The cases were arbitrarily divided into 2 groups on the basis of a 3 hour or 4 hour feeding schedule. In the infants on the 3 hour schedule, the mean age at onset of vomiting was 21.6 days. Those on the 4 hour schedule began to vomit at a mean age of 27.1 days. It was thus concluded that feeding is a necessary stimulus for the development of tumor and that, other things being equal, the more frequently the baby is fed, the sooner will symptoms develop.

When consideration was taken of the feeding schedule, there was no difference in time of onset between babies born at home and those born in the hospital. An incidental finding in the survey was that there was no increase in the disease in first borns over the calculated expectation. —*Lockert B. Mason, M.D.*

Palpable Contractile Pyloric Tumors in the Newly Born. W. S. CRAIG. *Arch. Dis. Childh.*, Lond., 1955, 30: 484.

THE AUTHOR believes that a palpable pyloric tumor does not have the same significance in infants less than 2 weeks of age as in older infants. To substantiate this belief a controlled clinical study was done on babies at the Leeds Maternity Hospital. The first group consisted of 21 infants less than 14 days old, in each of whom there was unsatisfactory weight progress associated with regurgitation or/and vomiting for more than 48 hours. The second group included 115 infants of the same age who did not exhibit any feeding difficulties. The material was otherwise unselected.

Abdominal palpation was done while the baby was being fed following gastric lavage. This method of examination apparently makes it possible to palpate the pylorus in a large number of newborn infants. A pyloric tumor was regarded as being present "if the palpable pyloric thickening (a) had definition, whether spherical or spinning top shape, (b) had an appreciably firm or distinctly hard consistency, (c) was felt to contract and relax repeatedly, (d) was felt on each occasion at the time of successive examination, and (e) was felt by more than one competent observer."

In 17 of the selected series of 21 infants who had feeding difficulties a tumor was palpated. An indefinite localized thickening was felt in 2, and in the remaining 2 no palpable abnormality was present. All of the infants were considered to have excessive mucus in the gastric lavage. Visible peristalsis was noted in all those with, and in 2 of those without, palpable tumor. Because of the severity and persistence of the symptoms, 3 of this series were subjected to operation. A pyloric tumor was confirmed in 2 of the 3, and relief of the symptoms followed the operation in all. The remainder of the patients was treated by gastric lavage with satisfactory results. The tumors continued to be palpable for 4 weeks to 3 months following discharge from the hospital, but all eventually disappeared.

Palpable tumors were found in 25 of the 115 infants in the control series who had no digestive disturbance. Excessive mucus in the gastric lavage was noted in 19 of these 25 infants. The pyloric tumor disappeared in all within 3 months after discharge from the hospital. Of the remaining 90 infants without palpable tumor, only 5 exhibited excessive gastric mucus. Interestingly, one of these 90 infants without a palpable pylorus to the age of 8 days subsequently developed hypertrophic pyloric stenosis at 4 weeks and was operated upon.

Barium x-ray studies were made of a number of patients in both series. As might be expected, the findings were variable and inconclusive. The author believes that the palpable pyloric tumor in these infants less than 14 days of age can be explained by spasm of a segment of pyloric musculature, stimulated into recurrent contraction and relaxation by filling of the stomach with a feeding. Presence of a palpable tumor in this age group does not usually signify organic hypertrophy. —*Lockert B. Mason, M.D.*

Subtotal Gastrectomy for Peptic Ulcer; a 1 Year to 4.5 Year Clinical and Laboratory Follow-Up. PAUL B. METCALF, JR., PHILIP COOPER, and REGINALD H. SMITHWICK. *Ann. Surg.*, 1955, 142: 924.

A THOROUGH ANALYSIS of the results of subtotal gastrectomy for peptic ulcer in terms of mortality, morbidity, postoperative complications, and later sequelae is presented. The authors believe that the study demonstrates the value of subtotal gastrectomy in the treatment of peptic ulcers requiring operation. The results in some cases, however, were sufficiently disappointing to suggest that the search for a more ideal operative procedure be continued.

Two hundred and sixty-nine males were subjected to subtotal gastrectomy for peptic ulcer. Of these, 190 had duodenal ulcers, 49 had benign gastric ulcers, 18 had both, and 12 had gastrojejunal ulcers. The indications for operation were reviewed.

The operations were performed by 18 surgeons in training. A two-thirds to three-quarters gastrectomy was performed in each case. It was not considered necessary to excise the duodenal ulcer as long as a satisfactory closure was accomplished at the duodenal level. Antecolic anastomoses were performed in practically all cases, All resections were of

the Billroth 2 type, and a Hofmeister type of anastomosis was employed.

There were 5 postoperative deaths, a 1.9 per cent overall mortality; all occurred in patients with duodenal ulcers (2.4 per cent for the duodenal ulcer group). Two of the deaths followed an emergency operation so that the mortality rate for elective procedures was 1.2 per cent. Two patients died of duodenal fistula; one patient died of a pancreatic fistula; one, of a coronary occlusion; and one, of electrolyte disturbance.

Two hundred and three patients (75 per cent) had uncomplicated convalescences. Minor complications delaying discharge up to an additional week occurred in 25 patients. Major complications which delayed the discharge of patients for more than an additional week occurred in 36 patients.

There were 4 known late deaths, all in the duodenal ulcer group. One occurred as a result of acute perforation of a gastrojejunal ulcer three weeks after discharge; one died of renal failure 8 months postoperatively; one died of coronary occlusion two days after exploration for jaundice, one year after gastrectomy. Seventy-seven per cent of the 260 survivors (201) appeared for follow-up.

The late major distressing side effects of subtotal gastrectomy were analyzed with special reference to weight loss, the dumping syndrome, disturbed meal pattern, mechanical symptoms, or decreased work capacity. There was remarkably little difference between the duodenal and the gastric ulcer group in the symptomatic comparison. None of the gastric ulcer patients developed a gastrojejunal ulcer. There were 9 proved or probable gastrojejunal ulcers in the duodenal ulcer group.

Complete gastric secretory studies were carried out on 141 patients after gastrectomy for duodenal ulcer, and on 31 patients after gastrectomy for gastric ulcer. Following insulin stimulation, 39 per cent of the postoperative duodenal ulcer patients showed free acid as compared to 6 per cent of the postoperative gastric ulcer patients.

The authors classify the results according to the criteria of Farmer and Smithwick and find the results for duodenal ulcer and gastric ulcer to be quite similar.

From their statistics and the literature, the authors conclude that subtotal gastrectomy in the treatment of peptic ulcer is a safe procedure insofar as mortality is concerned, but that it carries a significant morbidity. Subtotal gastrectomy provides good relief, but a return to complete normality is not to be expected. They further point out that although the actual incidence of proved gastrojejunal ulcer is quite low within the relatively short periods of observation, the incidence of persistent free acid is significantly high. The literature stresses the eventual occurrence of gastrojejunal ulcer in about 1 in 6 patients having free acid in the late postoperative period.

One in 13 patients subjected to subtotal gastrectomy of the extent outlined in this series and in the literature will be severely disabled by the late sequelae and in addition, one in 20 patients operated upon for duodenal or gastroduodenal ulcer will require further surgery for peptic ulcer.

Surgery, today, is the only form of therapy suitable for the patient whose ulcer does not respond to the usual medical measures, or who develops complications of the ulcer. The ideal surgical approach to this problem has not yet been settled. At present the biggest problems with subtotal gastrectomy are the frequent persistence of free acid postoperatively, the symptoms resulting from the small gastric pouch, and the disturbed physiologic pattern resulting from excision of a large segment of the stomach. The results of 50 per cent gastrectomy and vagotomy have been encouraging and if, in a comparative series, 50 per cent gastrectomy and vagotomy demonstrates a lower incidence of free acid postoperatively, and fewer undesirable late sequelae with no significant difference in morbidity, it should be considered as a more desirable procedure in the hands of those able to accomplish a satisfactory vagotomy without too much difficulty. —*Robert Paradny, M.D.*

Deficiency Syndromes Following Gastrectomy for Ulcer (A propos des syndromes multicarentiels des gastrectomies pour ulcéres). M. Morin, J. Graveleau, J. Lafon, R. Labet, and R. Pérol. *Presse méd.*, 1955, 63: 1798.

In a period of three years on a single medical service, 25 cases of deficiency syndromes following gastrectomy for ulcer have been seen. Fifteen of these are presented. There were 14 males and 1 female with an age range of 32 to 63 years, the average being 47. Twelve subtotal gastrectomies (two-thirds) with gastrojejunostomy, 1 subtotal gastrectomy with gastroduodenostomy, and 2 total gastrectomies were performed. In most cases, deficiency did not appear until several months after the operation. Twelve of the 15 patients received regularly three-quarters to one liter of wine a day postoperatively.

Tuberculosis was present in 3 cases. All patients were asthenic and anorexic, and most of them were impotent. Edema reached the point of anasarca in 3 cases, was moderate in 4, and absent in 8. Alpha globulin ratios were available in the group, but were low in those with anasarca. Weight loss in 10 cases averaged 10.5 kgm. (23 lb). Anemia (RBC < 3 million) was present in 8 patients, of whom 2 had macrocytic anemias; in one of these (a male) the condition developed 6 years after total gastrectomy. There was a normochromic anemia in 5 cases. Only the woman had a hypochromic anemia with low serum iron and response to iron therapy. Serum iron values were variable in the others. In all cases, gastrointestinal series was negative and acid after histamine was absent. Hepatomegaly was present in 12 cases, and liver histology was studied in 14 (12 biopsies, 2 autopsies). In all but 2 cases, cirrhosis, fatty infiltration, or hemosiderosis was found. Endocrine disturbance was suspected because of the appearance of the patient (sallow atrophic skin, brittle hair and nails, atrophic tongue, atrophic testis, pigmentation of exposed surfaces, though not of the buccal mucosa). 17-Ketosteroids were slightly low in all; the basal metabolic rate was low in 5. Glucose spillage was usually present in the 24-hour urine, but fasting blood sugar was normal in all; a diabetic glucose tolerance curve was present only in 4, while in 3 it

was low and flat and in 7 it showed a narrow spike and a hypoglycemic rebound.

—George S. Richardson, M.D.

Sarcoma of the Stomach; Analysis of 17 Cases. SEYMOUR OCHSNER and ALTON OCHSNER. *Ann. Surg.*, 1955, 142: 804.

Seventeen cases of gastric sarcoma were found among 150,000 consecutive admissions to the Ochsner Clinic and these comprise the material for this report.

There were 10 lymphomas, 6 leiomyosarcomas, and 1 neurofibrosarcoma. The average age of the patients with sarcoma was 57 years, and hence is comparable to the common age group of patients with gastric carcinoma. A greater incidence was noted in males. No specific symptoms or signs were common. X-ray findings are the most useful means of detection, yet a careful history and the physical findings must be ascertained prior to the barium studies.

Of the 10 patients with lymphomas, 6 were explored and 4 of these were subjected to resection. Five of these were dead within 6 months while the sixth is still alive. The 4 individuals not operated on included 2 who were in the terminal stage of their disease and 2 who lived from 12 to 18 months after x-ray therapy.

Five of the 6 leiomyosarcomas were resected and all of the patients have survived upward of 5 years. The inoperable patient survived 2 years. X-ray therapy is believed to be valueless in these tumors. The patient with the single neurofibrosarcoma also did very well after resection but has been lost to follow-up.

In the whole group of patients there were 298 with gastric malignancies and 17 with sarcomas. This 5.7 per cent is particularly significant in as much as the prognosis seems much better than with gastric carcinoma. It is particularly stressed that leiomyosarcomas should be attacked surgically with vigor regardless of the magnitude of the procedure as the results are so much more gratifying than in the case of gastric carcinoma.

—Robert W. Williams, M.D.

The Surgical Physiology and Management of Acute Intestinal Obstruction. PAUL NEMIR, JR., and HERBERT R. HAWTHORNE. *Surg. Clin. N. America*, 1955, 35: 1703.

IN ACUTE UNCOMPLICATED INTESTINAL OBSTRUCTION the primary pathologic physiology is related to fluid and electrolyte imbalance and dehydration. This is true whether the obstruction is high or low in the intestinal tract. In either instance fluid and electrolytes are lost to the body economy. As a result of a better understanding of fluid and electrolyte therapy, the mortality has been markedly reduced in uncomplicated obstruction.

If hemorrhage, shock, and electrolyte imbalance are successfully combated in strangulation obstruction and if survival is sufficiently prolonged, the gangrenous gut wall becomes permeable to its intraluminal contents and the fatal result is related to the absorption of toxic substances from the gut lumen. Whether the toxic component is bacterial in origin, a product of incomplete protein digestion, or an enzyme has not been entirely determined. It is probable that these factors are interrelated. The mortality in strangulation obstruction with gangrenous bowel remains around 30 per cent. The authors have demonstrated by spectophotometric findings an abnormal pigment, a hemin derivative not previously reported in vivo, present first in the gut lumen around 12 hours after strangulation, then in the peritoneal cavity, and finally in the blood stream. Death of experimental animals occurred shortly after the appearance of the fluid revealing the abnormal absorption spectrum in the peritoneal cavity.

The fundamental consideration in the management of acute intestinal obstruction is the interruption of the progression of events before strangulation occurs. The management of the patient with acute intestinal obstruction must be actively and immediately pursued along two general lines: (1) the prevention of distention, relief of the obstruction, and the removal of gangrenous gut from the peritoneal cavity if it is present, and (2) the prevention of shock, hemorrhage, dehydration, and electrolyte imbalance.

The administration of antibiotics is an integral part of the management of acute intestinal obstruction. Sulfonamide or antibiotic therapy is effective in decreasing the bacterial population in both the gut lumen and the peritoneal fluid. Antibiotics tend to preserve the architecture of the gut wall and postpone passage of intraluminal contents through the wall.

In acute, complete obstruction, the authors' policy, in general, has been to carry out early operation following an initial intensive period of preparation because they have not found any absolute diagnostic criteria which will differentiate simple, uncomplicated obstruction from strangulation obstruction.

—Edmund R. Donoghue M.D.

The Therapy of Perforated Peptic and Duodenal Ulcers (Ein Beitrag zur Behandlung des perforierten Magen-und Zwoelffingerdarmgeschwueres). RUDOLF TROMPKE. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955, 280: 552.

A CRITICAL EVALUATION of the so-called palliative operations in comparison to "primary resections" was made by means of histologic and follow-up studies. Resection leads to permanent cure by eliminating the primary focus of the disease. Resection is advocated provided there is a short interval between perforation and operation, the patient is able to stand the procedure, and competent surgery, careful anesthesia, and proper after-care are available. Age is not an absolute contraindication. Although it is preferred that the patient be under 50 years of age, a man of 68 withstood the procedure well.

By contrast, suture and omental tamponade is palliative and temporary. The patient is still exposed to secondary perforation, bleeding, and malignant degeneration. Furthermore, because of technical reasons a malignant condition may be easily overlooked in suturing. Histologic studies and x-rays show that with this method a cure is seldom achieved and a chronic stubborn gastritis is very common. Severe deformities and even stenosis are the consequences, often with minimal complaints. In a considerable percentage of cases there are severe complaints and working ability is markedly diminished. At best, the patient should remain permanently under surgical supervision.

—Sidney Smedresman, M.D.

Megaileum with Partial Strangulation. H. R. WAHL and H. M. FOSTER. *Am. Surgeon*, 1955, 21: 1238.

MEGAILEUM is classed with megaesophagus, megaduodenum, and sigmoid megacolon inasmuch as it represents a congenital dilated and hypertrophied segment of the gastrointestinal tract with no organic obstruction in the lumen of the involved intestine. Since the ganglion cells were intact in the mesenteric plexus, this case report was regarded as a unique example of an idiopathic congenital megaileum in a 10 year old boy who from birth had gastrointestinal distress and on whom a roentgenogram at the age of 6 months revealed an abnormality of the bowel.

The operative specimen was composed of a cystic intestinal mass, embedded in the center of a large segment of the small intestine and attached mesentery. The small intestine included a widely rounded dilated segment of the ileum 13 cm. in diameter, which was located 43 cm. from the ileocecal valve and 47 cm. from the proximal end of the resected intestine. The saccular dilation had two wide openings 8 cm. apart. The lower opening measured 18 mm. in diameter and opened into the lower end of the ileum which had gradually increased in diameter to 30 mm. where it entered the ileocecal valve. The other opening (upper) in the saccular dilatation was 27 mm. in diameter and was situated 8 cm. above the lower aperture and opened directly into the upper segment of the ileum.

It was thought that the child developed a volvulus in the small bowel above the sac, which produced strangulation with subsequent ileocolitis and symptoms of an acute abdominal condition. Complete recovery followed resection of the strangulated intestine and the congenital anomaly.

—*Stephen A. Zieman, M.D.*

Diffuse Nodular Submucosal Lipomatosis of the Ileum. ESTHER L. CHEATLE. *Q. Bull. Northwest. Univ. M. School*, 1955, 29: 330.

LIPOMAS constitute one of the frequent types of small intestinal benign neoplasms, and only mucosal adenomas and leiomyomas are more frequent in incidence. Abnormal fat deposits in the small intestine may take one of several forms. These include the single discrete lipoma, multiple separate lipomas, the diffuse confluent type, and the lipomatosis and fat infiltration of the submucosa without tumors.

Whereas the single discrete lipoma is not infrequent, only 7 cases of multiple lipomas and 4 cases of diffuse nodular lipomatosis have been reported in the literature. The ileum is the portion of the small intestine which is most frequently involved. In most cases symptoms are absent. When present, however, they are mainly those of chronic obstruction. Seldom are these tumors palpable. Occasionally x-rays will reveal a filling defect with the rounded contour suggesting a benign process. In the cases of multiple lipomatosis the roentgen findings may resemble inflammation, carcinoma, or benign neoplasms. The etiology of these tumors is unknown. They are usually composed of mature fat with no evidence of cellular activity. These tumors usually arise in the submucosal layer.

A case is presented of diffuse nodular lipomatosis in a 33 year old colored woman who was admitted to the hospital because of a gynecological problem. At the time of laparotomy an abnormal area of ileum was noted and it was resected. The resected ileum had a total length of 82 centimeters, and 72 centimeters of the removed small bowel showed numerous soft, rounded, confluent nodules projecting into the lumen. Microscopic examination revealed these nodules to consist of adult adipose tissue in the submucosa layer. The only symptom in retrospect included slight nausea following the ingestion of food.

—*W. Harrison Mehn, M.D.*

Argentaffin Carcinoma of the Ileum with Raised Serum 5-Hydroxytryptamine; Report of a Case. DAVID DUNCAN, JEAN D. GARVEN, and JAMES L. GIBBONS. *Brit. M. J.*, 1955, 2: 1586.

THE AUTHORS review the literature concerning a syndrome of intermittent attacks of flushing, cyanosis, dyspnea, abdominal pain, diarrhea, and occasionally pulmonary stenosis occurring in conjunction with argentaffin (carcinoid) tumors of the gastrointestinal tract.

5-Hydroxytryptamine (5-H.T.) has been recovered from both the serum and tumor tissue of these patients in markedly increased amounts. This substance is also excreted as 5-Hydroxyindoleacetic acid (5-H.I.-A.A.) in increased amount in the urine.

5-Hydroxytryptamine normally occurs in the argentaffin cells of the gastrointestinal tract and in blood platelets.

Various endocrine functions such as control of peristalsis, stimulation of intestinal glandular secretion, vascular homeostasis, nerve metabolism have been attributed to 5-H.T. Increased excretion of 5-H.I.A.A. may occur in patients with argentaffin tumors but without the syndrome described previously.

Hepatic metastases have been present in all cases with flushing and cyanosis and therefore resection of the primary tumor has not resulted in cessation of these symptoms.

The authors have tabulated all reported cases and present a similar case with a primary argentaffin tumor of the ileum with mesenteric node and hepatic metastases. They were able to recover increased amounts of 5-H.T. in the serum and markedly increased 5-H.I.A.A. from the urine of the patient. Further interesting data are presented concerning the chemistry and bio-assay of these interesting substances.

—*Luther M. Keith, M.D.*

Primary One-Stage Proctocolectomy in Ulcerative Colitis. E. S. R. HUGHES and W. E. KING. *Austral. N. Zealand J. Surg.*, 1955, 25: 124.

TOTAL PROCTOCOLECTOMY is advocated in all cases of ulcerative colitis which require ileostomy, because the incidence of recurrence of the disease and of carcinoma is too high to warrant taking the risk of allowing any part of the colon or rectum to remain. It is the authors' opinion that the more desperate the patient's condition, the more urgent is the need for colectomy and an ileostomy can always be accompanied by a colectomy. As a further argument in favor of immediate colectomy, they point out that when a patient recovers from the acute phase and postpones further operation indefinitely, excision of the rectum becomes a difficult dissection because of the deposition of ex-

cessive fatty tissue around a very contracted bowel, together with the partial or complete obliteration of tissue planes.

It is emphasized that the operation should be planned so that: (1) the most involved portion is attacked first (usually the rectum), and (2) the operation can be terminated at a moment's notice should the patient's condition become grave. When the decision is made to operate, further delay is avoided. No special bowel treatment is needed because there is no soiling of tissues in this operation. It is also stated that blood loss can be minimized by infiltrating the perianal and perirectal tissues with adrenalin in saline solution (1 to 250,000).

The authors present 6 cases in which a primary one-stage proctocolectomy was performed for ulcerative colitis.Two were complicated by stricture; one of these was malignant. Two were of a relapsing type and came to surgery with spread of the disease, and two were cases of acute fulminating disease with hemorrhage. All but one patient could be considered to be serious risks because of weight loss, dehydration, and/or hemorrhage. One patient died on the twelfth postoperative day as a result of pulmonary embolism. A skin graft of the ileostomy was done in all of the cases. The protocol shows that 3 of the patients had ileostomy stenosis. Of the remaining 2 survivors, one had a very recent condition. The authors report their views concerning the skin-grafted stoma elsewhere. —*David T. Petty, M.D.*

Total Colectomy for Ulcerative Colitis (Colectomie totale pour colite ulcéreuse). F. De Bie, A. Lacquet, and J. Vandenbroucke. *Acta gastroenter. belg.*, 1955, 18: 962.

Following a review of the characteristics, complications, indications for, and results of, various forms of surgery in ulcerative colitis, the authors describe 7 cases of ulcerative colitis in which treatment consisted of abdominal colectomy, ileostomy, and closure of the rectum beneath the peritoneum of the pouch of Douglas.

Although many cases of ulcerative colitis respond well to conservative treatment, acute toxic ulcerative colitis, which makes up 5 per cent of the total group, carries a mortality rate of 73 per cent for a 9-year period of medical treatment only. During an acute attack of ulcerative colitis, the 24-hour losses from the colon may equal 100 to 200 grams of protein and 100 to 300 cubic centimeters of blood. Ileostomy under these circumstances may add a major water and electrolyte loss to these other losses and allow continuation of toxic reabsorbtion from the colon. Various estimates state that between 70 and 100 per cent of ileostomy patients eventually require colectomy for control of their disease.

In the authors' series of 7 cases of serious ulcerative colitis treated by colectomy, the indication for operation in all cases was poor control of the disease by other means. The duration of symptoms ranged from 1 to 7 years. Four of the patients had had previous ileostomies, and one of the remaining patients had had a cecostomy for free perforation of the cecum. Two patients had had perforation of the left colon subsequent to ileostomy, responding to drainage of a subphrenic abscess in one instance and conservative therapy in the other. There was one death from hepatic coma in a patient who had remained ill despite an ileostomy two years previously. All other patients are well following colectomy, although a sufficient follow-up on the behavior of the remaining rectum is not yet available. —*Robert S. Shaw, M.D.*

Rectal Hemorrhage in Babies from Functional Mesenteric Intestinal Infarction (La hemorragia rectal en el niño por infarto intestino mesenterico funcional). Osvaldo Demo. *Bol. Soc. cirug.*, Córdoba, 1955, 16: 127.

Rectal hemorrhage does not constitute a disease in itself, it is rather a symptom. Bleeding through the anus necessitates a study of the mechanisms which may produce hemorrhage as well as of the anatomicopathologic process involved.

The literature on gross intestinal hemorrhage fails to mention mesenteric infarction as a causative agent. Three cases are presented, the incriminating factor of which was an intestinal irritation causing congestion with edema. Pathologic specimens verified the diagnosis. For this reason the term functional mesenteric infarction was given and the lesion was relieved by local instillation of 1 per cent novocaine solution and the administration of an antihistaminic substance.

The etiopathogenesis was considered to be a reflex mechanism associated with the sympathetic nervous system. —*Stephen A. Zieman, M.D.*

Schoemaker's Method of Reconstructing the Sphincter Ani. R. Ruding. *Arch. chir. Neerl.*, 1955, 7: 304.

Insufficiency of the anal sphincter is usually congenital or traumatic in origin. The most well known type of this condition is that due to direct injury associated with parturition. Weakness of the sphincter following anal fistulectomy occurs only occasionally. Dysfunction of the sphincter may also result from neurosyphilis or from a gradual nonspecific paralysis.

In order to treat a patient suffering from the latter form of anal sphincter insufficiency, the author revived the operation described by Schoemaker in 1909. Through bilateral oblique incisions extending from coccyx to greater trochanter, the inferior margin of each gluteus maximus is exposed. A bundle of this muscle, 4 centimeters in width, is severed at its insertion and dissected free, with preservation of the nerve supply (inferior gluteal nerve). The gluteus bundles are passed through tracts undermined ventral and dorsal to the anus, and are sutured to the contralateral ischium and to each other.

Following this operation continence was almost completely restored in the case reported.

—*Edward M. Miller, M.D.*

LIVER, GALLBLADDER, PANCREAS, AND SPLEEN

Some Effects of Interrupting Hepatic Blood Flow. Theodore Drapanas, Donald R. Becker, Guy S. Alfano, William H. Potter, and John D. Stewart. *Ann. Surg.*, 1955, 142: 831.

An experimental study on 44 dogs with interruption of the arterial flow to the liver was done in order to

determine the critical point of tolerance of the liver for suspension of its portal and arterial inflow. The completeness of the interruption of the hepatic blood flow was carefully checked in all of the animals. It was found that hepatic devascularization lasting 90 minutes or longer was fatal and that the clinical course was uniform in all cases. After interruption of hepatic blood flow for a lethal period, with subsequent restoration of flow, the average duration of survival was 10 hours. By contrast, if blood flow was not restored the average survival time was 33 hours. When the blood flow to the liver was restored after the liver was subjected to ischemia of lethal degree a severe fall in blood pressure was the rule. Blood transfusion protected the animal to some extent from the immediate hypotension, but did not prolong survival.

The cause of hypotension and death following interruption of the hepatic blood flow beyond a critical point was not lucidated by these experiments.

—John E. Karabin, M.D.

Aneurysm of the Hepatic Artery (Das Aneurysma der Arteria hepatica). W. Hess and A. Celio. *Helvet. chir. acta*, 1955, 22: 286.

The authors, of the Surgical Department of the University of Basel, Switzerland, report a case of aneurysm of the hepatic artery which was cured by surgery.

The patient, a man 38 years of age, had undergone a cholecystectomy for cholelithiasis. Beginning 9 months after the operation, repeated attacks of hematemesis, melena, and colic set in. At laparotomy an aneurysm of the hepatic artery of tangerine size was found, which was filled with old blood coagula and occupied the entire space between the liver and the duodenum. The duodenum was dissected from the aneurysm, and the entire hepatoduodenal ligament was clamped off with an intestinal clamp. The communication between the sac and the artery was sutured, the largest portion of the sac was extirpated, and the remaining portion was closed by aneurysmorrhaphy to reinforce the suture of the artery. The patient recovered and had no further complaints.

Only103 cases of extrahepatic aneurysm have been reported in the entire literature. They may be caused by infection, arteriosclerosis, choledocholithiasis, or trauma. The prognosis is poor; of the 103 patients only 6 survived. Ligation of the hepatic artery involves the risk of fatal liver necrosis. A number of patients treated by this method succumbed to this complication. Only one other case is on record in the literature in which the patient was cured by aneurysmorrhaphy.

—Werner M. Solmitz, M.D.

Primary Carcinoma of the Gallbladder; a Review of 33 Male Cases and Literature. John H. Mohardt and Joseph C. Brettner. *Q. Bull. Northwest. Univ. M. School.*, 1955, 29: 386.

Primary carcinoma of the gallbladder terminates fatally and patients with this disease seldom survive 5 years. The course of the disease has not been altered significantly by modern diagnostic methods and treatment. Multiple reports in the literature confirm the observation that when confronted with this tumor we seldom have much to offer.

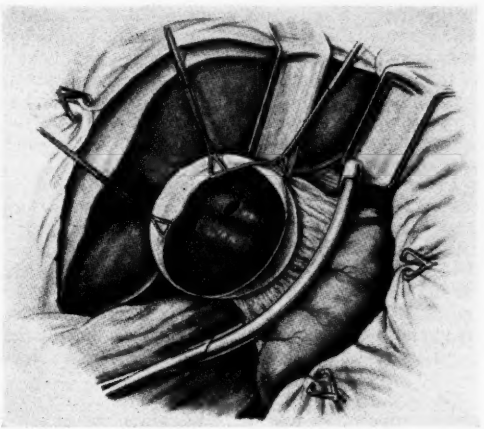


Fig. 1 (Hess, Celio). Site of the aneurysm. After clamping of the hepatoduodenal ligament the aneurysmal sac has been opened. The communication with the artery is visible at the floor of the sac.

It is estimated that about 6,000 deaths occur from this tumor yearly and a survey discloses that it appears in from .33 to .85 per cent of all autopsies and from 3 to 6 per cent of all cancers. It ranks sixth among the gastrointestinal cancers, preceded by cancer of the stomach, rectum, colon, cecum, and esophagus. It is found in from 0.5 to 7.5 per cent of all surgical disease, and in 3 to 14 per cent of all gallbladder autopsies. Gallbladder carcinomas are more frequent than biliary duct carcinomas, and it is recorded that from 70 to 100 per cent are associated with calculi. It is estimated that 3 to 8 per cent of all cases of gallstone will develop gallbladder carcinoma.

The disease has been generally accepted as being most commonly found in the sixth and seventh decades, with the average age about 57 years. It accounts for approximately 10 per cent of all gallbladder surgery after the age of 70, and it is four to five times as common in women as in men before the fifth and sixth decades, with a ratio of 3 females to 1 male. One-third of the patients have been in the forties.

The clinical, surgical, and autopsy significance of the association of calculi, infection, and gallbladder carcinoma has been observed and emphasized repeatedly since the latter half of the nineteenth century. Reports give the incidence of calculi associated with gallbladder cancer as ranging from 65 to 100 per cent, the average being 85 per cent.

Experimental attempts to produce gallbladder tumors in guinea pigs by introducing gallstones, beads, and other foreign bodies have not been generally successful, and certainly the great majority of persons who develop gallstones do not develop cholecystic cancer. Constant and chronic irritation has been shown to potentiate carcinogenic effects in animals and it is reasonable to presume that it may do so in human beings.

The early signs and symptoms of gallbladder cancer are indistinguishable from, and are those of, benign

gallbladder disease, usually associated with calculi. The symptoms of cancer appear only when the disease has extended beyond the confines of the gallbladder to the liver, bile ducts, duodenum, omentum, colon, peritoneum, and the biliary and periaortic nodes. The widespread dissemination is explained by the diffuse lymphatic drainage of the gallbladder and adjacent regions.

In sixty per cent of cases symptoms have been present less than one year and usually not more than from 3 to 6 months, with or without the presence of preexisting gallbladder disease. Most authorities agree that acute symptoms or sudden changes are rarely present for more than 6 months. In late cases, a hard tumor in the region of the gallbladder, progressive weight loss, cachexia, anorexia, and jaundice (if the ducts are involved or pressed upon by the tumor or metastases) are significant.

Carcinoma of the gallbladder is rarely diagnosed preoperatively because of the variety of possible symptoms and the absence of a definitive pattern of disease. A change in intensity and persistence of symptoms from those of previous gallbladder disease is of significance. Pain, weight loss, anorexia, jaundice and cholecystitis were among the most consistent findings in this group. In early lesions surgical therapy and cure is possible, but when the tumor has spread beyond the gallbladder the prognosis is poor.

Radiographic and Other Studies of the Biliary and Pancreatic Ducts. HENRY WAPSHAW. *Brit. J. Surg.*, 1955, 43: 132.

A STUDY was made of 56 patients, 48 of these had primary biliary tract disease and 8, pancreatic disease. Neohydriol was injected, usually through a catheter in the common bile duct, or a cholecystostomy tube. Five normal duct patterns were recognized, the most common being a curve beginning at the retroduodenal portion of the common bile duct with the concavity facing to the patient's right side. It is stressed that a knowledge of the course of the common duct may be important in planning an end-to-end repair after excision of a stricture, as advocated by Cattell. The intrahepatic ducts were visualized, depending upon the amount and fluidity of the contrast material plus the force of injection.

Disorders of the sphincter of Oddi were not noted. A pancreatic duct was visualized in 14 per cent of the patients, and a comparison made with an overall average visualization of pancreatic ducts during cholangiography of 33.5 per cent of 1,521 cases taken from the literature. The junction of the common bile and pancreatic ducts must occur proximal to the sphincter of Oddi for pancreatic reflux to occur. When morphine was given it produced a compression of the terminal portion of the common bile duct in 78.3 per cent of his cases, lasting from four minutes to two hours. Pancreatic reflux occurred in only one case. Overlooked stones are suggested by translucent areas surrounded by contrast medium, and inverted cup-shaped defects, or a sharply outlined defect in the contour of the duct.

Although raised serum enzyme levels occurred, significant reactions to cholangiography are rare. Only the terminal part of the pancreatic duct was visualized when reflux occurred, probably due to continued secretion by the pancreas.

—*Roger D. Williams, M.D.*

Contribution to Biliary Radiomanometry According to the Caroli Method on the Operating Table; Importance of Duodenotomy in Conjunction with Choledochotomy (Contribution à la radiomanométrie biliare selon la méthode de Caroli sur table sarcophage; importance de la duodénotomie conjuguée à la cholédocotomie). J. STALPORT, E. NICOLAS, A. DEMELENNE, J. ROSKAM, and CL. ROSKAM. *Acta chir. belg.*, 1955, 54: 730.

THE AUTHORS emphasize the importance of radiomanometric control during operations on the biliary tract. Only this procedure reveals the presence of unsuspected obstacles in the common bile or the hepatic ducts. This is of special value in patients who did not have clinical symptoms of choledocholithiasis and in whom only radiomanometry reveals calculi in the common bile duct. On the other hand, in many cases radiomanometry proves the absence of concretions which had been suspected by the clinical course and so obviates unnecessary opening of the choledochus. For the purpose of radiomanometry during surgery the authors constructed a special table (table sarcophage) which has been described in detail in another article.

In the present article the writers describe the technique and discuss a series of 124 cases in which surgery of the bile tract was performed. There were 72 choledochotomies, 26 cases of drainage of the common bile duct, 21 duodenostomies, and 18 other interventions.

For radiomanometry the catheter is introduced in the common bile duct via the cystic duct with help of the Caroli trocar. If, in rare cases, the cystic duct is not permeable it is either dilated with a probe of plastic material, or the choledochus is punctured directly. In some cases manometry is impossible because of a stone at the junction of the cystic and common bile ducts. Only roentgenography, after removal of the stone, will show the permeability of the biliary ducts. During the manometric examination a number of roentgenograms are taken, one or two after manual compression of the distal portion of the choledochus so that the hepatic canals are visualized by the reflux of the contrast material.

If no concretion is found in the common bile duct the cystic duct is closed and the gallbladder removed by the retrograde route. If, on the other hand, a calculus is found and a transpapillary drain is put in the choledochus, the authors believe it essential to do a duodenotomy at the same time. It is extremely difficult to pass a catheter or drain from the common duct beyond the sphincter of Oddi. This is caused by the fact that the chloedochus can be stretched considerably and the surgeon may easily believe that he has passed the papilla although this has not been the case. Of 21 cases in which the authors were convinced they had passed the papilla, duodenotomy revealed that in only 2 had they succeeded in doing so.

They use the following technique: after choledochotomy a forceps equipped with an eye hole is introduced in the choledochus and advanced toward the papilla. The anterior aspect of the duodenum is opened by a very small incision, 2 to 3 mm. in length. Under

direct control of the eye, the calculus forceps is made to pass the papilla. A double thread is passed through the eye hole of the forceps; then the forceps is retracted from the duodenum into the choledochus so that two threads pass the papilla. The long branch of the transpapillary drain is then attached to one of the threads and pulled back into the duodenum across the papilla. The thread is cut and the incision of the duodenum is closed. Then the choledochus is sutured and the gallbladder is removed.

The indications, the findings at operation, and the results are discussed and tabulated. The indications included: cholelithiasis, choledocholithiasis, odditis, pancreatitis, and stenoses of the choledochus by scars or neoplasms. In 26 of the 124 cases a transpapillary drain was used; in 21 of these, duodenotomy was done in the manner described.

—*Werner M. Solmitz, M.D.*

Calculi in the Biliary Ducts (Die Steine in den Gallengaengen). A. W. FISCHER. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955, 282: 810.

ALTHOUGH the possibility of formation of a stone in the common duct cannot be denied because calculi are found in 30 per cent of cases with congenital absence of the gallbladder, the majority of stones derive from the gallbladder.

If biliary colics of long standing are replaced by constant pains and, especially, if the latter are associated with icterus, suspicion of a stone in the common duct is justified.

The first step in cholecystectomy should be the ligation of the cystic duct, to prevent an escape of the stones into the common duct during operative manipulations.

The employment of biligrafin enables us to visualize the biliary ducts in from 70 to 80 per cent of cases.

As a rule, the presence of a stone in the common duct serves as an indication for operation.

Operative cholangiography renders great services in cases in which there is an indication for exploration of the common duct, because the number of stones removed can be compared with the number of those visualized. Unfortunately, the method is not yet perfected, as some stones may be overlooked while, on the other hand, certain shadows may be wrongly interpreted as calculi. A second picture should be taken after removal of the stones.

The author favors exploration of the common duct with a scoop held in the left hand, the surgeon standing on the patient's left side. He is opposed to routine dilatation of the papilla in each instance. Manometric determination of the pressure within the biliary tract is not considered valuable for the diagnosis of stones.

Some of the beneficial results of papillotomy are attributable not to the operation per se but to the suggestive-hypnotic effect which subsides within a few months. A neurologist should be consulted before recommendation of a papillotomy.

It is not advisable to carry the horizontal branch of the T-tube through the papilla into the duodenum. In order not to deprive the body of bile, the author introduces through a hollow probe a capillary plastic tube leading from the common duct into the duodenum. This is done before the T-tube is placed into the common duct. Starting on the first postoperative day, the bile collected is reintroduced through the capillary tube, either plain or mixed with glucose or sodium phosphate.

If the common duct is very wide and the fear is justified that kinks may prevent the bile from flowing into the duodenum, the author prefers cholecystoduodenostomy to a T-tube. The danger of ascending cholangitis has been overemphasized. The anastomosis is performed also if the bile contains gravel or if the papilla is abnormally narrow.

—*Joseph K. Narat, M.D.*

Recurrent and Residual Stones in the Common Bile Duct. E. S. R. HUGHES. *Brit. J. Surg.*, 1955, 43: 198.

FIFTY-FIVE PATIENTS were reoperated upon following previous cholecystectomy. Stones were found in 36 cases; 29 of these originally had biliary colic with jaundice, 1 had had colic without jaundice and 6, acute cholecystitis. The common duct had been explored in 20 cases and stones were found in 16. In the majority of the patients, recurrent symptoms developed within three years of the first operation. Twenty-nine were seen with biliary colic and jaundice, 3 with biliary colic without jaundice, 1 with jaundice without pain, and 3 with persistent biliary fistula.

Eight of the 36 patients required a third operation for the removal of stones. Another, with stones, was moribund, on admission and one refused a needed operation.

The evidence for new stone formation is summarized: the finding of stones in congenital absence of a gallbladder; the formation of stones in the common duct around silk sutures; the finding of stones in the duct with none in the gallbladder; the late finding of stones in a previously explored duct; and the long interval between the initial operation and the later finding of stones. It is pointed out that stones can form in the cystic duct stump, but it appears that most of these stones are overlooked at the first operation because of inflammatory obscuration, difficulty in accurate palpation of the closed duct or in exploration of the open duct, difficulties in the use and interpretation of cholangiography due to stones left in the cystic duct.

The author had no success in a limited use of solvents. He advises delay in secondary intervention when retained stones are recognized immediately after the initial operation. In re-exploration, he advises routine removal of cystic duct stumps, the employment of operative cholangiography, duodenotomy, and incision of the intramural portion of the common bile duct when necessary. Choledochoduodenostomy has not always succeeded in preventing stone re-formation.

—*Hermes C. Grillo, M.D.*

The Pathologic Physiology of Postoperative Complications in Cholelithiasis (Misserfolge und Beschwerden nach Gallensteinoperationen im Blickwinkel der Pathophysiologie). WERNER BLOCK. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1955, 282: 795.

IN THE YEARS between 1923 and 1955 some 100,000 operations were performed on the biliary system by 31 authors. The average mortality figure was 8.6 per cent and ranged from 0.27 to 22 per cent. If these data

are compared to the statistics of Hotz's in 1923 which showed an operative mortality of 9.28 per cent in 12,144 cases, one wonders if any advance was made in these 30 years. The improved anesthesia, preoperative and postoperative care, and the antibiotics should change the figures for the latter years, but one must also consider that indications for surgery especially in the older age group increased markedly. However, the surgical mortality compares favorably with the mortality of the medically treated cases with a rate ranging from 13 to 16 per cent. The mortality in the author's clinic since 1946 was 6 per cent in 1,047 cases of surgical procedures on the biliary system and 2.1 per cent for simple cholecystectomies. The major decrease in operative mortality in the last 30 years was found in relation to the incidence of postoperative peritonitis.

The medical and surgical literature indicates that after operations on the biliary tree some 5 to 40 per cent of patients will have residual complaints. The functional association of the liver and kidney and the functional derangement of the extrahepatic biliary tree are two entities in direct relationship to the postoperative complications in cholelithiasis, omitting the problem of residual stones. In the hepatorenal functional correlation, liver damage can injure the kidneys and vice versa, or a common factor can be injuring both organs simultaneously. Of the author's mortality 16.3 per cent was due to the "hepatorenal syndrome." While it is possible to demonstrate pathologic changes in just one of the organs on occasion, functional disturbances can be demonstrated, establishing such a joint participation. The clinical picture observed was one of azotemia and hyponatremia in one group of cases, and gastrointestinal disturbances associated with icterus, hemorrhages, and subsequent azotemia in the other. A rather surprising occurrence in some patients was complete liver failure after bile drainage was initiated and an obstruction of the biliary tract successfully released. The deamination mechanism seemed to be primarily at fault. As such situations occur more often in acute cases of stress than in interval operations, the contributing factors may be of adrenal origin. Similar clinical pictures, at times, were caused just by the loss of bile through drainage and inadequate replacement. Therapeutically, hepatodiuretin, urea, hypertonic dextrose, amino acids, electrolytes, and serum albumin were administered.

Such liver dysfunction must be differentiated from the dysfunction of the extrahepatic biliary tree. Vagal stimulation causes the liver to become hyperemic and after sphincter spasm and subsequent bile stasis the hyperemia is even increased. An ectasia of the common duct may then occur without choledocholithiasis. As part of the entity of "ductal dyskinesia," stimulation of the splanchnic nerves increases the motility and tonus of the biliary tree, while vagus stimulation abolishes this effect. The intricate functional relationships remain obscured. It is not clear if the sphincter in the neck of the gallbladder described by Luetken and the sphincter of Oddi function synergistically or antagonistically. The sphincter of Oddi has a nervous mechanism which is independent of the duodenum and this might be one reason for postoperative dysfunction. It is interesting to observe that the fewer the pathological findings in the gallbladder, the more postoperative complaints may be expected, although the opposite is not true. After cholecystectomy, hyperirritability of the sphincter of Oddi might be remaining.

Although in true hypertrophies or scarring of the papilla of Vater, sphincterotomy, dilatation, and anastomoses may be indicated, these procedures are rather crude and do not seem to get to the root of the problem of functional derangements. Serial cholangiography and radiomanometry as initiated by Mirizzi and Mallet-Guy may reveal if hypotonia or hypertony of the bile ducts is the cause of postcholecystectomy complaints. The question may arise if splanchnicotomy, sympathectomy, or vagotomy have anything to offer. Because of the lack of fundamental knowledge at the present time, it is impossible to recommend these procedures for the relief of "biliary dyskinesia" after cholecystectomy. Conservative therapy should be used although paravertebral novocain block at T9 and T10 on the right side may be tried with success.

—Karel B. Absolon, M.D.

GYNECOLOGY

UTERUS

Mixed Mesodermal Tumors of the Uterus; a Clinicopathologic Study. MICHEL THIERY and ALEXANDER BRUNSCHWIG. *Acta obst. gyn. scand.*, 1955, 34: 301.

IN A PERIOD of six years, 11 cases of mixed mesodermal tumors of the uterus were seen on the Gynecologic Service of Memorial Hospital. During this same period approximately 2,400 malignant tumors of the female genital tract were seen. Eight tumors were corporeal, representing 2.3 per cent of all corpus malignancies, and 2 were cervical, representing 0.13 percent of cervical malignancies.

The patients in the present series were postmenopausal (10 of 11) and complained first of abnormal vaginal bleeding (9 of 10). The symptoms are not pathognomonic of the disease, but in most respects resemble those of cervical or corporeal cancer.

Histologically, mixed mesodermal tumors of the uterus are composed of two or more intimately intermingled mesodermal constituents, some of which may be heterotopic in the uterus. Usually a glandular element and various sarcomatous tissues are found. The bulk of the tumor is comprised of malignant connective tissue stroma of varying density, and only occasionally does myxomatous tissue become predominant. The diagnosis is essentially a pathologic one.

The mode of spread is discussed. The prognosis depends on the time at which therapy is undertaken, the extent of spread, and the treatment. X-ray therapy of these tumors is considered to be without value and more radical pelvic surgery is stressed.

—*M. Leon Tancer, M.D.*

Reappearance of a Cervical Carcinoma 30 Years After Treatment with Radium. JOHN HOWKINS and JAMES D. ANDREW. *J. Obst. Gyn. Brit. Empire*, 1955, 62: 870.

A 38-YEAR-OLD WOMAN who had borne 6 children was found to have a cervical cancer (stage unstated) which was treated by radium needle implantation. One month later, an intra-abdominal needle implantation was made. These radium needles were fitted into a rubber pouch sutured into the cul-de-sac. The radium and holder were removed 24 hours later. This treatment took place in 1925, and the dosage of radium is unclear. Unfortunately, neither the original slides made from the cervical biopsy, nor the original pathologic report are available. However, the clinical description of the original lesion lends credence to the diagnosis of carcinoma.

The patient was followed for the next 14 years, with no evidence of recurrence. She was then seen again 29.5 years after the original treatment. At this time an ulcerative lesion of the cervix was found, on biopsy, to be a squamous cell epithelioma. A Wertheim hysterectomy was performed with great difficulty because of dense pelvic adhesions.

The question of whether the malignancy represented recurrence or new growth remained undecided.

—*Alan Rubin, M.D.*

ADNEXAL AND PERIUTERINE CONDITIONS

Tumors of the Ovarian Mesenchyme; a Clinicopathologic Survey. J. HENRY BIGGART and C. H. G. MACAFEE. *J. Obst. Gyn. Brit. Empire*, 1955, 62: 829.

ONE HUNDRED AND TWENTY-SEVEN tumors of the ovarian mesenchyme, from the files of the Queen's University, Belfort, Ireland, are reviewed.

The essential relationship of the fibroma, thecoma, thecagranulosa cell tumor, and granulosa cell tumor is emphasized.

Brenner tumors appear to possess a thecal stroma, which, in occasional patients, is sufficiently active to produce estrogenic effects. —*Alan Rubin, M.D.*

Masculinizing Ovarian Tumors (Les tumeurs masculinisantes de l'ovaire). PIERRE BROCQ, CLAUDE ROUVILLOIS, and PIERRE MATHET. *Presse méd.*, 1955, 63: 1782.

THE AUTHORS summarize a longer work by Pierre Mathet (Les tumeurs masculinisantes de l'ovaire. *These de Paris*, 1954). The world literature yields 210 cases of masculinizing ovarian tumors; 67 per cent of the patients were under 35 years of age, while 40 were in the menopause, the age extremes being 4 and 85 years. When reported in 146 cases, the right side was more commonly affected, and in 5 cases the involvement was bilateral. The only familial instances were a mother and daughter who had the tumors 25 years apart, and 2 sisters who had tumors.

The clinical features were those of masculinization; the important differential diagnoses being male pseudohermaphroditism and the androgenital syndrome. Waugh, in 1949, favored diagnosis by laparotomy. Hallet and Holler, in 1953, reported a bilateral subtotal adrenalectomy in a patient finally cured by removal of the ovarian tumor. The 4 year old patient of Levesque (1953), on the other hand, had an enlarged adrenal gland as shown by roentgenography, but 17-ketosteroid chromatography was characteristic of gonadal excretion and the patient was cured by removal of an arrhenoblastoma.

In 33 cases reported in the literature 17-ketosteroid analysis was performed: in 10 arrhenoblastomas and 11 lipoid-cell tumors elevation was present, while in the remaining 12 cases there was none. In 9 cases the 17-ketosteroids were fractionated by digitonin precipitation into β (containing dehydroepiandrosterone and characteristic of adrenal origin) and a (androsterone, etiocholanolone—not characteristic); and in these cases the latter and not the former were elevated. One case (Schockaert, Devis), however, was consistent with adrenal origin except for fraction 2 and the 20-ketosteroids, and was thought to be ectopic adrenal tissue in the ovary.

Pathologically, Robert Meyers' classification (1930) is favored: 1, Arrhenoblastoma, divided into (a) adenoma tubulare testiculare ovarrii, a testislike tumor with tubular and Leydig-like elements that seldom virilizes; (b) atypical type with sarcomatoid struc-

ture and poor tubule formation if any; (c) an intermediate group; and 2, the virilizing lipoid cell tumor, the structure of which in some cases resembles adrenal zona fasciculata, while in others crystalloids of Reinke similar to those of the testis are found.

Upon excision of a virilizing tumor menstruation may be resumed immediately, 17-ketosteroids return to normal, and hair is slowly lost, but the low voice and enlarged clitoris tend to persist. These patients are not infertile: before appearance of symptoms there were 150 pregnancies in 61 cases; during the symptoms there were 7 pregnancies (2 of the patients died later of atypical arrhenoblastoma) with 4 normal children, 1 masculinized girl, 1 female pseudohermaphrodite, 1 abortion; following treatment there were 47 pregnancies in 39 cases. A malignant condition (with fatality) was present in 32 of 158 patients with arrhenoblastomas (21 per cent) of which two-thirds were of the atypical type; and in 5 of 46 patients with virilizing lipoid cell tumors (10 per cent). The question of whether bilateral oophorectomy should be done is thus a difficult one to answer in these young women.

—*George S. Richardson, M.D.*

Prognosis of Ovarian Seminomas and a Discussion of Therapy Based on 5 Unreported Cases and 150 Cases from the Literature (Pronostic des séminomes des ovaires et associations thérapeutiques à propos de cinq observations inédites et de 150 cas étudiés dans la littérature). PIERRE BROCQ and CLAUDE MADIER. *Mem. acad. chir.*, Par., 1955, 81: 943.

THE AUTHORS present 5 cases of seminomas of the ovary and make an evaluation of the methods of therapy available at the present time as they believe that there are enough series in the literature which will permit the making of a prognosis. One of the authors analyzed 150 cases which had been published after 1945. The seminomas of the ovary as well as those of the testicle are malignant tumors. This is a remarkable observation and frequently unjustifiable as these tumors can be cured when certain surgical rules are respected and when other therapeutic methods are used in conjunction with surgery, mainly x-ray therapy, because the seminomas of the ovary are very radiosensitive. However, it is difficult to predict which patient will benefit from the treatment and in which delayed dissemination will occur.

The ages of the authors' patients varied from 13 to 48 years. The factors influencing the prognoses are discussed. After the age of 40 years the prognosis is very poor. Up to the age of 15 years the prognosis is serious but more favorable. The best results are obtained between the ages of 16 and 25 years.

In the presence of metastases or bilateral tumor it cannot be determined if the opposite tumor is or is not another primary growth. Muller reports an 89.9 per cent cure after 5 years in cases of unilateral tumor with an intact capsule against a 29.4 per cent cure in cases of bilateral tumor, and one of 25.3 per cent when metastases are present. These figures were considered optimistic by the authors.

Among the authors' 12 cases of tumor with metastases there were 8 deaths, 6 of them in one year; among 10 cases of bilateral tumor there were 7 deaths, 5 of them in one year.

In discussing therapy of the seminomas in general it is better to exclude the patients more than 40 years of age, the bilateral tumors, and the tumors with metastases. The presence of hemorrhagic ascitic fluid is of serious prognosis. The presence of adhesions about the tumor also indicates a poorer prognosis because of frequent incomplete resection or rupture during removal, but the prognosis is improved in these cases if postoperative x-ray therapy is given. The progressive rise of the level of the prolans in the blood is of importance and suggests recurrence of the tumor.

No prognosis can be made from the histologic appearance of the tumor and the prognosis is worse if the seminoma is associated with a teratoma.

The decision as to therapy has to be made at the time of surgery and the knowledge that the tumor in question is malignant is of great advantage. The macroscopic appearance of the tumor is of no aid.

Radical surgery however, has the following disadvantages: (a) the results of bilateral oophorectomy and hysterectomy are not much better than those obtained by simple excision of the tumor, (b) the preservation of the possibility of pregnancy in a young woman is to be considered, and (c) the remaining ovary is regarded as contributing to a good result.

These arguments should be accepted with great reserve because of the relatively frequent occurrence of metastases in the remaining uterus and ovary. X-ray therapy and further surgery can always be employed, but radical surgery offers a better prognosis. Estrogens can always be used as replacement therapy.

The authors' approach to the different problems is as follows: (a) in bilateral tumors with metastases or dense adhesions to the other abdominal organs they resort to total hysterectomy and bilateral oophorectomy without considering the age of the patient; (b) for patients more than 30 years of age with one or more pregnancies they perform hysterectomy and bilateral oophorectomy; (c) for patients under 15 years of age the gravity of the prognosis has priority over the future, and with an unquestionable pathological report radical surgery is the choice; (d) for patients between the ages of 15 and 30 years radical surgery is done in spite of the desire for pregnancy and psychological and social factors.

For completion of the treatment roentgen therapy should be used because of the high sensitivity of the tumor, and especially in the cases in which surgery was unsatisfactory because of adhesions, rupture of the capsule, or incomplete resection.

Another problem is presented by the cases in which only a unilateral oophorectomy was performed and the postoperative pathological report is seminoma. Careful follow-up of the patient will permit the early discovery of recurrence. Surgery should be limited to single metastases and should be followed by roentgen therapy. If surgery is not feasible, x-ray therapy offers hope of a good result.

Hormone therapy with androgens is discussed as well as the use of antigonadotropic substances, and finally it is reported that nitrogen mustard produced regressions lasting up to 3 years.

In conclusion, in the choice of therapy the precise diagnosis by frozen section associated with a preopera-

tive evaluation of the level of the gonadotropins is the basis for a better decision. A good follow-up with frequent re-evaluation of the gonadotropins is a measure which will improve the prognosis.

Hellmut Mattheis, M.D.—

Association of a Thecoma and a Uterine Adenocarcinoma (Association d'un thécome et d'un adénocarcinome utérin). MAURICE MAYER. *Gyn. obst.*, Par., 1955, 54: 452.

THE FINDING of an adenocarcinoma of the uterine corpus together with a thecoma of the ovary is reported. The patient, 62 years of age, was 6 years postmenopausal. A preoperative vaginal smear (Shorr stained) indicated unusual estrogenic activity for a postmenopausal woman. There was no other indication of estrogenic effects. A Papanicolaou smear and hysterogram prior to operation demonstrated the intrauterine malignant condition. A Shorr-stained smear after total hysterectomy and bilateral salpingo-oophorectomy indicated a return to a nonestrogenic state.

Reports on the etiologic role of estrogen-producing tumors in fundal malignancy are reviewed. No specific conclusions concerning this relationship are drawn with regard to this patient.

—George C. Lewis, Jr., M.D.

MISCELLANEOUS

Osteoporosis Following Castration (Les ostéoporoses de castration). A. J. BRET and M. BARDIAUX. *Rev. fr. gyn. obst.*, 1955, 50: 295.

IT is a well known fact that a spontaneous and artificial menopause can affect the ligamentary and osseous system of a large per cent of patients. The ovary, and lately the suprarenal gland, have been found to play an important role in the metabolism of the steroids.

Clinically, the pains which occur have a dull character, sometimes occurring in paroxysms as lumbago. The localization is usually restricted to the lumbosacroiliac region and between D4 and D7. On examination, one finds that there is no contracture of the muscles and that the mobility of the spine is not affected. The pain area is also vaguely specified by the patient.

Roentgenograms of the entire spine should be taken in the upright and recumbent positions for comparison. One finds that there is a definite decalcification process and that the superior and inferior borders of the vertebrae are somewhat more dense in aspect. The vertebrae show some alterations in their structure because of this decalcification process. Some lipping may be present and the vertebrae may very often look biconcave. The intervertebral discs may look enlarged and a picture of vertebral osteochondritis may be visible. A certain degree of kyphosis and scoliosis is sometimes apparent and it is very difficult to determine if it is recent in origin. While osteophytes are rare, calcifications of the costal cartilage are present more frequently. Congenital anomalies may also be the cause of similar pain.

The symptoms seem to appear a few years, sometimes 10, after surgical castration. A number of these patients, even before their surgery, had severe gynecological troubles and were very often sterility problems. The immediate cause for surgery was usually the presence of fibromyomas rather than adnexal disease.

Sometimes less characteristic symptoms such as diminished hearing, psychological instability, and sexual frigidity may be present. On examination, one finds a well developed female without the usual concommitant signs of the normal menopause, and it seems rather paradoxical to find a patient who has been castrated for 10 years without signs of estrogen privation.

Biochemical studies of the urinary output of steroids reveal the more characteristic element of this syndrome. The phenol steroids have been found to be increased up to 500 y. Traces of butylo-soluble glyceronidate and pregnandiol were present, the 17-ketosteroids were always decreased, and the cholesterol dosage was constantly elevated.

It is difficult to find an appropriate classification for this syndrome and it seems better to consider it as a process following castration in which the osseous manifestations are more prominent. The origin of this syndrome is based upon a hyperestrogenemia or, better, a disharmony between the ovary, suprarenal gland, and the hypophysis. The increased output of phenolsteroids in a castrated patient is due primarily to an increased functioning suprarenal gland uncontrolled by the absent ovary. The reason for the decalcification is still uncertain. One theory attributes it to the calcium metabolism in the presence of a diseased ligament while another supports the catabolism-anabolism effect of the suprarenal and sexual glands.

Climacteric osteoporosis should be treated at sight with estrogen when the syndrome is due to hyperestrogenemia. The authors have used a male hormone mainly because: (1) the 17-ketosteroid output is often decreased; (2) the male hormone is antagonistic to estrogenic secretion; (3) testosterone has a blocking effect on the hypophysis and sometimes on the suprarenal cortex; and (4) testosterone has an anabolic effect on the protein metabolism.

Oral treatment has proved to be inadequate and therefore testosterone propionate in doses of 300 mgm. monthly has been injected. Later, a 300 mgm. pellet can be implanted or a monthly dose of 250 mgm. of testosterone propionate can be given.

Within a few days, the pains cease and hearing and sexual ambition are improved. There is, however, no change visible in the roentgenograms. Within 3 or 4 years, medication can be abandoned.

—Robert O. Verheecke, M.D.

The Pathogenesis of Endometriosis; an Experimental Study. G. LEVANDER and P. NORMANN. *Acta obst. gyn. scand.*, 1955, 34: 366.

ENDOMETRIOSIS, the occurrence of endometrium outside the uterine cavity, has heretofore been explained by the embryonic theory and the implantation theory. The experiments described in this paper are ingeniously conceived and performed, and are designed to prove still another and more comprehensive theory than either of the former. The induction theory states that chemical substances or small particles in the endometrium can be liberated from the cells, pass

into the environment, and there activate an omnipotent blastema to endometrial formation. These specific substances are compared with the embryonic organizers or inductors of the Spemann theory of epigenesis.

—M. Leon Tancer, M.D.

A Case of Chorionepithelioma Presenting with Subarachnoid Hemorrhage. R. M. E. Seal and A. H. Millard. *J. Obst. Gyn. Brit. Empire*, 1955, 62: 932.

An unusual presenting symptom in a case of chorionepithelioma is reported.

The patient, aged 28, was admitted with symptoms of severe frontal headache, blurring of vision, and back pain of 3 days' duration. Five months previously she had given birth to a normal child, following which she had frequent, prolonged vaginal bleeding. Spinal puncture revealed fluid which was xanthochromic and which was uniformly bloody.

During the next 2 months the condition progressed rapidly. The patient developed hematuria, a rapidly enlarging mass in the right loin, and two lumps in the right breast. She experienced massive hemoptysis and showed evidence of secondary tumor in the lungs. A Hogben test was positive in a dilution of 1/10 but negative at 1/100. Upon laparotomy, the abdomen on the right was found to be filled with tumor, the left kidney was enlarged, and the ovaries were almost entirely replaced by small cysts. Endometrial curettings were normal. The cysts were reported as follicular cysts and the peritoneal surface had the appearance of decidua. The patient developed masses in the triceps, over the scapula, and in the anterior abdominal wall. She died within 2 months of the onset of symptoms.

Autopsy revealed the tumor to involve the breast, triceps, abdominal wall, scapular muscles, pleurae, lungs, mesentery, both kidneys, and the right occipital lobe of the brain. The uterus was sectioned at 5 mm. intervals and was normal.

The tumor was typical of choriocarcinoma, showing characteristic syncytial and Langhans' elements. Mitotic figures were absent. Tumor emboli were observed in the vessels in the area of the cerebral hemorrhage.

It was felt that the cerebral hemorrhage was a part of the one disease process and might be explained by the natural tendency of trophoblastic tissue to invade the vessels. In view of the irregular postpartum bleeding, it was believed that this tumor originated in the uterus and later regressed.

The true nature of this type of tumor and its origin are discussed. Emphasis is placed on the difficulty of making a histologic diagnosis during life.

—John J. Bergan, M.D.

Postmenopausal Metrorrhagia Due to a Complex Hormone Secreting Tumor of the Ovary; Folliculoma, Lutein Folliculoma, Thecoma; Attempt at Prognostic Interpretation (Métrorragies post-ménopausiques dues a une tumeur complexe de l'ovaire hormono-sécrétante; folliculome, folliculome lipidique, thécome; essai d'interpretation pronostique). Huguette Le Lièvre and P. Isidor. *Gyn. obst.*, Par., 1955, 54: 441.

A case is reported in which a mixed cell ovarian neoplasm was discovered 6 years after the menopause. The presenting symptom was irregular vaginal bleeding. Prior to operation an adnexal mass the size of an orange was noted on the right side. Hyperplasia of the endometrium and myometrium was considered to be evidence of ovarian hormone activity by the tumor. Microscopic evaluation of the tumor revealed areas of granulosa, lutein, and theca cells. In a few sections of the tumor and meso-ovarium the presence of anaplastic cells in the lymphatics suggested a poor prognosis despite the fact that the patient had been followed postoperatively for 3 years without evidence of recurrence. The apparent mixed nature of the tumor favored a mesenchymal origin rather than a germinal source for this type of neoplasm.

—George C. Lewis, Jr., M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Conquest of Eclampsia. FREDERICK H. FALLS. *J. Am. M. Ass.*, 1956, 160: 251.

ALTHOUGH THE ETIOLOGY of eclampsia and pre-eclampsia is as yet undetermined there has been considerable progress in the reduction of mortality due to this complication and also to the frequency. Progress in the treatment was observed in a teaching hospital, a large charity supported institution, and a large general hospital. The importance of prenatal care was emphasized.

The patients who develop uncontrollable toxemia during the prenatal period are hospitalized, placed on a reduced salt intake and physical activity, and carefully observed. Failure of control was considered sufficient to indicate interruption of the pregnancy either by induction or by cesarean section. The convulsive form of eclamptogenic toxemia has practically been eliminated in the three hospitals mentioned. In spite of this improvement, toxemia still continues to be a major cause of maternal mortality in the United States. Toxemia can be eliminated by the application of these principles. —*James F. Donnelly, M.D.*

The Thrombophlebitis of Pregnancy (Les thrombophlébites de la grossesse). P. MORIN and J. CHABRIER. *Gyn. obst.*, Par., 1955, 54: 400.

THROMBOPHLEBITIS involving the deep vessels of the legs with peripheral circulatory embarrassment has rarely been described. Five recent cases form the basis of this study. The clinical manifestations of this illness are obscure during pregnancy. The onset appears to be slower and less dramatic in comparison with the process in the postpartum period. Pain and peripheral edema form the basis of the diagnosis. The use of arterial oscillometry is an aid in establishing the diagnosis. At first the oscillations appear slightly increased; later there is a marked reduction in amplitude, and finally the oscillations increase greatly over the original alterations. A study of coagulation factors and serum globulins showed no alteration from normal in the 5 cases.

In contrast, an evaluation of 200 postpartum cases of thrombophlebitis has shown marked alterations in the alpha and gamma globulins. The changes in these serum proteins have proved useful in following the course of postpartum thrombophlebitis.

All of the patients were treated with heparin intravenously. Anti-vitamin K preparations and dicumarol were considered too hazardous in pregnancy. Three patients responded promptly prior to delivery and developed no recurrence or embolus. One who had a continuation of her disease into the postpartum period also experienced pulmonary embolism just prior to delivery. One patient had a prolonged recovery during her antepartum course. The last patient had a recurrence of thrombophlebitis following cesarean section. The patient with postpartum relapse and the one with the embolus exhibited marked globulin alterations only in the postpartum period. This suggested that thrombophlebitis following delivery must differ in some unknown manner from that observed prior to parturition. —*George C. Lewis, Jr., M.D.*

Heart Disease in Pregnancy. KRISTIAN GOLDEN. *Acta obst. gyn. scand.*, 1955, 34: 412.

A STATISTICAL STUDY of heart disease complicating pregnancy is presented. The material was drawn from a four-year study during which 10,324 patients were delivered. Of these, .31 per cent had heart disease. A control group representing every fiftieth patient was also studied.

Approximately two-thirds of the patients with heart disease could trace their lesions to rheumatic fever. The functional capacity of the group was good, as 26 of the 31 patients were estimated to be in class 1 or 2.

Several generalizations could be made from the data presented. Spontaneous delivery following a normal labor was tolerated surprisingly well by the cardiac patients. It was believed, therefore, that abdominal delivery should be done for obstetric rather than for cardiac indications. Blood loss during delivery was significantly less in the cardiac patients. The incidence of toxemia was much higher than in the control group. Also, the birth weight of the babies was less on the average in those patients with heart disease although the duration of gestation was not less. —*John J. Bergan, M.D.*

Pregnancy and Carcinoma of the Cervix; the Significance of Cytologic Findings (Schwangerschaft und Carcinoma colli; Bedeutung des zytologischen Befundes). G. AMBROSIO. *Arch. Geschwulstforsch.*, 1955, 8: 339.

THE COMBINATION of cervical cancer and pregnancy is a rare occurrence. In the later months of pregnancy the bleeding that occurs must be differentiated from placenta previa and premature detachment of the placenta.

The author reports the case of a 35 year old gravida-5 who was admitted at term in early labor. She gave a history of painless vaginal bleeding for 4.5 months. Vaginal examination revealed an ulcerated cervix which was dilated approximately 3 centimeters. A cervical scraping smear and a biopsy were taken. The former showed squamous cells suggestive of malignancy. The biopsy report several days later disclosed invasive, poorly differentiated, squamous-celled carcinoma. A cesarean hysterectomy was performed on the basis of a rapid smear report and x-ray therapy was administered later.

—*Warren R. Lang, M.D.*

The Fetus Can Bleed; Three Clinicopathologic Pictures. BRUCE CHOWN. *Am. J. Obst.*, 1955, 70: 1298.

THE AUTHOR reports 2 cases of nonhemolytic hemorrhage of the newborn with recovery, and 1 case of fatal hemorrhage in an erythroblastotic baby.

In the first case the mother lost more blood in the third stage of labor than usual, and a gross defect was found in the placenta. It is suggested that the fetus bled into and through its placenta, producing anemia in itself and a concealed retroplacental hemorrhage in the mother.

In the second case it was proved that the baby had bled symptomlessly into the mother's circulation, and that the bleeding had been going on probably for several weeks before delivery.

In the third case the mother had a chill and fever a few hours before delivery. There was a small defect in the placenta; the baby began to bleed a few minutes after birth. It is suggested that the mother's chill and fever were reactions to transfusions of the incompatible blood of the baby, and that the bleeding in the baby in some way resulted from this reaction.

Charles Baron, M.D.

LABOR AND ITS COMPLICATIONS

Intrauterine Rupture of Fetal Vessels During Labor. JOHN P. MICHAELS. *Am. J. Obst.*, 1955, 70: 1251.

THERE is an apparent lack of interest in anemia of the newborn due to severe fetal blood loss during labor.

Three personal cases of intrauterine rupture of the fetal vessels in labor have been presented. One infant died in utero, one was salvaged by immediate transfusion, and one required no special treatment. This condition is apparently not so rare as has been reported.

In the event of delivery of a shocked and pallid infant, prompt inspection of the cord and placenta is imperative. The diagnosis actually depends on "a high index of suspicion." It is the immediate responsibility of the attending obstetrician to make the differential diagnosis of posthemorrhagic shock in the newborn.

Treatment consists of combating the shock with warmth, oxygen, and prompt replacement of the blood loss by transfusion. —*Charles Baron, M.D.*

The Transitional Anomalies of the Lumbosacral Joint; Prognostic Element for the Trial of Labor in Certain Contracted Pelves (Les anomalies transitionnelles de la charnière lombo-sacrée élément de pronostic de l'épreuve du travail dans certains bassins limites). F. LEPAGE, L. LEMERRE, and S. VERT. *Gyn. obst.*, Par., 1955, 54: 431.

IN A STUDY of 62 patients given a trial of labor for contracted pelvis, there was noted a 53 per cent incidence of anomalies of the lumbosacral joint. This finding differed significantly from that in a group of 235 patients in whom studies (urographic, barium enema, etc.) were made for other purposes. In the latter group, the same anomalies were discovered in only 8 per cent.

The outcome of labor in the 62 patients was correlated with the type of lumbosacral joint. A more favorable result occurred when the joint was normal or exhibited lumbarization of the first sacral vertebra. When there was partial or complete sacralization of the fifth lumbar vertebra the incidence of failed trial was greatly increased. This difference in the results of labor was attributed to alteration in the location of the promontory, and to variation in the contour of the anterior sacrum. Sacrilization resulted in an elevated promontory and a convex superior surface of the sacrum. Both of these factors in a narrowed pelvis will tend to obstruct the passage of the presenting part. In all cases in which a trial of labor is anticipated for a narrow pelvis, the lumbosacral joint deserves careful evaluation. —*George C. Lewis, Jr., M.D.*

Anesthesia in Cesarean Section; Classical Methods and New Techniques (L'anestesia nel taglio cesareo; considerazioni sui metodi classici e sulla esperieza delle nuove tecniche di anestesia). EMANUELE LAURICELLA. *Clin. ostet. gin.*, 1955, 62: 241.

THE AUTHOR discusses the pathologic and physiologic aspects of obstetrical anesthesia with special reference to fetal oxygenation, asphyxia, and respiratory depression of the newborn. These problems are closely related to placental permeability of the various agents used, and to the maternal and fetal risks involved, particularly when dealing with premature infants.

Chloroform, a protoplasmic poison, is highly toxic to liver cells already under the stress and strain of pregnancy.

Ethylene is explosive and lacks the advantages of cyclopropane.

Trichlorethylene is analgesic only, and is not very useful in obstetrics.

Ether inhalation has the widest safety margin, with no action on hepatic or renal cells and no interference with the acid base equilibrium. Respiratory complications are rare. Nitrous oxide is useful as an induction agent prior to ether inhalation.

Cyclopropane is inflammable, but is desirable because of its relaxing power and the high percentage of oxygen that is possible with it.

Barbiturates give rise to fetal narcosis. Atropine is the usual preanesthetic medication; it is used in doses of 0.5 to 1 milligram. Local anesthesia is reserved for patients with severe cardiac conditions, for diabetics, and for instances in which there is greatly impaired fetal vitality.

Epidural anesthesia is rarely used. Caudal anesthesia presents many technical difficulties, as well as the danger of accidental intromission of the agent in the spinal canal. Spinal anesthesia has resulted in many deaths on the operating table, and frequent cases of shock; Brouha reports 2 deaths among 33 cases. Greenhill estimates the maternal mortality with spinal anesthesia to be about 1 per cent. The author's belief is that spinal and ether inhalation are the two most satisfactory methods available. His personal choice is ether as the best all around method. Spinal anesthesia results in sudden hypotension, which is dangerous to the mother in particular; also, its use should be avoided in cardiac and toxic patients. Vasopressors such as noradrenalin and ephedrine sulfate, administered intramuscularly, should always be used with spinal anesthesia.

Attention is called to the fact that it is not the patient who must conform to the anesthesia, but the anesthesia to the patient, and each patient must be studied individually. Hospitals lacking well organized anesthesia departments do well to concentrate on the two most popular methods—ether and spinal anes-

thesia—and the author repeats that ether is the safest method in the vast majority of cases.

Hospitals with well organized anesthesia departments can use curare in the form of d'tubocurarine, which is noted for its great relaxing power. In cesarean sections, the technique consists in using cyclopropane induction for about 5 minutes, then 5 milligrams of curare via saline or glucose infusion, as a test dose. If no reaction occurs, 20 milligrams of curare are administered in the same way. The operation is continued under intratracheal ether, or a reduced concentration of cyclopropane (20 to 30 per cent); at times both are used, thus assuring full relaxation and maximum respiratory control. To combat shock and to offset vagal action, 40 milligrams of mephedine are added to the infusion. When the visceral peritoneum is incised, cyclopropane is discontinued and oxygen is given to help the fetus. The operation is completed under nitrous oxide. To neutralize the curare, one milligram of atropine and 2 milligrams of prostigmine are given intramuscularly.

—*Vincent Ippolito, M.D.*

PUERPERIUM AND ITS COMPLICATIONS

Puerperal and Abortional Infections Due to Aerobic Nonhemolytic Streptococci. HILDRED M. BUTLER, ALISON W. JOHNS, and MARIANNE LOWEN. *Med. J. Australia*, 1955, 42: 1089.

A THREE AND ONE-HALF YEAR STUDY of genital tract infections is presented by the authors. There were 2,617 puerperal and abortional cases which showed direct smear findings which were typical of uterine infection. Of these, 60 per cent showed clinical evidence of infection and nearly all of the others showed objective manifestations of infection. Sepsis due only to the aerobic nonhemolytic streptococcus was found in 174 cases. A mixed infection was present in another 84 cases.

Identification of the streptococci showed 206 strains of group D, 17 strains of group D which failed to react with the precipitin serum used, 3 strains of group B, and 32 unidentified strains. The precipitin serum was later found to be faulty, so all of the group D were considered together in the study.

Light was thrown on the true nature of the 84 mixed infections by the occurrence of two similar cases. In both cases, group D streptococci and Bacterium coli were found in the cervical smears. In the first case the smear was thought to be typical of a Bacterium coli wound infection. Bacterium coli were found in the patient's blood culture. In the second case the findings were reversed.

A valuable lead was obtained when it was found that in the direct smear the streptococcal infection displayed mainly round elements while in the other case the cocci were mainly oval elements. It was concluded that the direct smear was a reliable guide to the significance of these bacteria when they occurred in combination with significant numbers of other forms.

The infections were of a serious nature in only 19 of the 224 cases; in 16 of these the infection was puerperal. In 12 of the abortional cases the infection was due to group D streptococci, while the other 3 abortions (including one death due to endocarditis) were due to mixed infections.

In general, the infections with group D streptococci were more severe than those with the unidentified cocci. This was thought to be due to the greater resistance of the former to penicillin, which was the first antibiotic started in most of the patients.

Factors predisposing to infection with the streptococci included local conditions favoring infection such as long-standing ruptured membranes, previous infection which had responded to penicillin and sulfonamides, excessive blood loss, and trauma. Nine of the 19 severe cases and 20 per cent of the mild cases were receiving, or had recently received, penicillin therapy at the time the infection occurred.

In reviewing the cases of genital tract infection for the five-year period immediately preceding the time of the study, the incidence of aerobic nonhemolytic streptococcal infections was found to be 3 per cent. This contrasted with the figure of 8.5 per cent determined in the current study. The increased incidence was felt to be due to the introduction of penicillin. Penicillin was previously implicated as a predisposing factor in the development of these infections.

—*John J. Bergan, M.D.*

GENITOURINARY SURGERY

ADRENAL, KIDNEY, AND URETER

A Rare, and Perhaps not Previously Described, Malformation of the Renal Pyramids and Fornices (Su una rara, e forse non ancora descritta, malformazione delle piramidi e dei fornici renali). G. DELL'ADAMI and G. BORELLI. *Arch. ital. urol.*, 1955, 28: 386.

THE PATIENT was a 7 year old child suffering attacks of violent pain in the right upper abdomen, radiating to the right inguinal region. The attacks were accompanied by vomiting and meteorism.

Roentgenologic examination revealed the presence of numerous pea-sized or smaller stones in the right kidney. Pyelographically the upper calyces were somewhat dilated; the lower calyces were not visualized. Some of the stones appeared to lie deeper in the kidney parenchymal tissues than the calyces. The kidney was removed and the removed specimen studied macroscopically and microscopically.

Injection of the intrarenal passages and dissection of the specimen disclosed the fact that the aforementioned stones were located either in the pelvis, the calyces, or in cystlike cavities within the renal parenchyma. These cavities were demonstrated, by the injection method used, to communicate by narrow passages with the major calyces of the lower part of the kidney and with a minor calyx of the upper group of calyces. All the calyces involved in the process were without a trace, as seen in contour, of a papillary structure. The stones fitted the form of the cavities and were composed mainly of oxalates and phosphates of calcium.

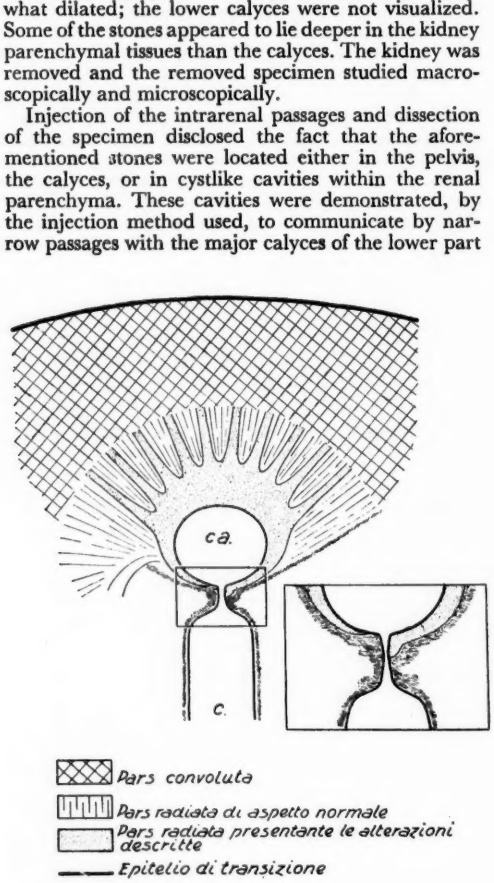


FIG. 1 (Dell'Adami, Borelli). In this figure the attempt is made to depict schematically the configuration of one of the pyramids with its respective calyx.

When cut and stained, the cavities here described were found to be lined with a typical transitional epithelium supported by a dense and thick connective tissue layer. Outside of this connective tissue layer, particularly in the direction of the calyx, were masses of lumina resembling those of glandular ducts. Some of these lumina were lined by cylindrical epithelium; some were larger and lined by flattened epithelial cells and some ended blindly; some emptied into the cystlike structure itself. These structures were on the whole intermixed without evident order; however, strips of these disordered structures tended to radiate from the cystlike structure toward the periphery of the pars radiata of the kidney parenchyma and to alternate with the radiating tubules of the normal pars radiata (Fig. 1).

The greater part of the duct between the cystlike cavity and the cavity of the renal pelvis was surrounded by a rather abundant tissue of muscle fibers with prevalent transverse and intersecting courses. This muscle tissue continued downward, permeated more or less by the afore-described lumina, to become continuous with the muscular sphincteric tissue of the calyx, and upward, that is, peripherally, some as far as to reach the level of the arciform vessels; others were bluntly interrupted before reaching this level. Over these blunt stumps of muscle fascicles the tubular lumina were arched. The calyces were somewhat dilated and lined with transitional epithelium.

The authors believe that the youthful age of the patient, the lack of evidence of inflammatory processes or their residue, and the odd structural components described suggest the origin of the anomaly to be on a congenital basis. They do not attempt to speak in this connection more specifically, as the embryology of this region is not too well understood.

Since Damm described this phenomenon under the designation of pyelogenic cyst, it has been variously termed as urinary cyst by Rayer in 1841, as intrarenal cyst by Koehler, and as renal diverticula by various authors. On the other hand, Moore refused to recognize the condition as an individual nosologic entity per se, but interpreted the findings in his cases as a partial or total dilatation of the calyx and designated it a hydrocalicosis. —*John W. Brennan, M.D.*

The Lymph Circulation of the Kidney and Its Significance for Particular Pathologic Processes of the Kidney (Uber den Lymphkreislauf der Niere und dessen Bedeutung fur einzelne pathologische Prozesse der Niere). A. BABICS and F. RÉNYI-VÁMOS. *Zschr. Urol.*, 1955, 48: 618.

MUCH OF THE INFORMATION on the lymphatics of the kidney is probably faulty because the anatomic de-

scriptions of lymph vessels are based on studies utilizing the injection of dyes. Such studies are not reliable because they reveal tissue spaces as well as lymph vessels, and they are therefore misleading. Kaiserling and Sootsmeyer in 1939 ligated the efferent vessels of the rabbit's kidney and succeeded in demonstrating the lymph vessels of the kidney in this manner. The lymph vessels become distended and can then be easily seen and traced. No connection was found between the lymphatics of the renal capsule and the lymph vessels of the renal substance. The lymph vessels in the kidney pursue a paravascular but not a perivascular course and enter a lymphatic plexus at the renal hilus. The authors repeated the studies of Kaiserling and Sootsmeyer and were able to confirm their findings. A large number of lymph vessels are demonstrable in the renal substance, but there are very few lymphatics in the renal capsule. Lymphatics are also quite sparse in the renal pelvis and in the calyces.

A great deal about the circulation of lymph and other tissue fluids in the kidney is still unknown. Why albumin in the interstitial substance is removed through renal capillaries and why erythrocytes, leucocytes, and bacteria are drained off through the lymphatics is still puzzling; nor is it known how tumor cells get into the lymphatics.

In the rabbit, ligation of the pelvis leads to dilatation of the lymphatics. This is not due to compression of these vessels by the distended pelvis because the lymphatics of the renal pedicle are also dilated. The dilatation of the lymphatics is due to their distention with an albumin-containing fluid which is also present in the interstices. The ensuing edema is particularly noticeable in the renal medulla. After ligation of the pelvis, the rabbit's kidney increases in weight by 40 to 60 per cent. This phenomenon must be looked upon as a compensatory mechanism and is not due to obstruction. Following pelvic ligation also, it is believed that large quantities of histamine (H substance) liberated in the kidney result in an increase in the permeability of the capillaries, which in turn permit an accumulation of the albumin-containing fluid in the interstitial spaces. After ligation of the renal pelvis, intravenous inulin, para-aminohippuric acid, and indigo carmine appear within minutes in the obstructed pelvis. The kidney therefore continues its activity despite the block. The renal pelvis will dilate considerably after ligation and peristaltic activity of its musculature ceases. Urine which trickles into the pelvis returns to the kidney substance through vessels in the calyceal fornices. This, the authors believe, leads to an increase of the histamine content of the interstitial fluid, and the rise in histamine increases the permeability of the capillaries. Large quantities of blood proteins will, therefore, seep into the interstitial spaces and cause the kidney to swell with edema. According to Hinman, Fuchs, Strong, and others, the renal parenchyma degenerates because of compression of the renal arterial tree (anatomic atrophy) and because the intrarenal pressure on the parenchyma itself leads to atrophy (mechanical atrophy). The authors do not agree with this concept and believe that internal changes in osmotic pressure and changes in the lymph and interstitial fluid circulation are responsible for the degeneration of the kidney. Total destruction of the kidney following pelvic block does not occur in 1 or 2 weeks but takes a year or two. This is an important consideration in the management of ureteral calculi which block the renal pelvis but which eventually pass spontaneously.

It is generally believed that in ascending pyelonephritis, bacteria enter the lymphatics of the renal pelvis and extend from there into the lymphatics of the kidney itself. As evidence that this is so, the authors cite the perivascular accumulation of white blood cells. They have shown, however, that the lymphatics of the kidney do not take such a course, and they therefore believe that lymph cell infiltration occurs in the interstitial spaces and not within the lymphatics themselves, and that the lymphatics of the kidney are not the route by which infections enter the kidney, but on the contrary they are the route by which infections leave the kidney.

The induration of the perinephric fat in the chronically infected shrunken kidney is believed to be due not only to the direct extension of the renal infection to the perinephric fat and to that of the renal hilus, but also to the initial edema and the outpouring of albuminous matter within the fat, which eventually leads to an increased amount of scar tissue.

When the flow of urine from the kidney is blocked by a ureteral stone it is the lymphatic drainage of the kidney that prevents the dilatation of the kidney for a long time and therefore permits a conservative management and obviates the need for hasty surgery. An obstructing renal stone, on the other hand, one that is not associated with infection, should be removed as soon as possible to prevent the excessive scarring of the perinephric fat. In cases of renal stone associated with pyelonephritis, the scarring of the perinephric fat may compress the blood supply to the kidney and hasten its destruction. This is seen also in staghorn calculi of the kidney. Indurated perinephric or periureteral fat should be removed surgically to improve the eventual postoperative result. A narrow pelvis, narrow calyces, and a narrow ureter, when seen in patients with chronic pyelonephritis, is believed to be an unfavorable prognostic sign and may well be due to compression of these structures by the scarred fat within the hilus of the kidney and about the ureter.

—*S. Richard Muellner, M.D.*

Surgical Management of Transcapsular Rupture of the Kidney; 24 Cases. R. FRANK JONES. *J. Urol.*, Balt., 1955, 74: 721.

A PLAN of early investigation in cases of renal trauma is presented. Preliminary care consists of treating the shock and screening by excretory urography for evaluation of kidney damage. If the urogram is negative and no mass is present, and hematuria is declining or ceasing within 24 hours while the blood pressure is maintained, retrograde studies can be deferred for several days. A retrograde urogram is indicated when the excretory urogram is not clearly negative, when there is a mass in the flank, when hematuria persists or recurs after abatement, when infection intervenes, and before hospital discharge of every patient with

even suspected trivial renal trauma. The comparative superiority of retrograde over excretory urography is overwhelming.

A diagnosis of transcapsular renal rupture is made whenever urography demonstrates extravasation through the renal tissue into the renal fossa. Therapy in transcapsular rupture is always surgical, planned to suit the general and specific conditions of the patient as immediate or deferred. Surgery may extend from simple drainage of the renal fossa, thorough removal of the blood clots and degenerated fat, to apposition of the kidney laceration, and partial or total nephrectomy. The first consideration is the life of the patient.

Surgical intervention is indicated at the optimum time to save the patient's life, to effect the most conservative procedure, and to preserve function with the least possible morbidity. When possible, the ruptured kidney is repaired by suturing the true capsule and/or binding with figure-of-eight chromic catgut regular or ribbon sutures. Partial nephrectomy may be tenable. Nephrectomy is performed only when the damage is irreparable or as a life-saving measure.

Immediate shock due to trauma itself or secondary shock caused by blood loss demands priority care. The criterion of 100 plus systolic pressure before surgical intervention is recommended. Hematuria recognized on voiding or catheterization after injury is generally present in cases sustaining external violence, but may be absent in cases of spontaneous renal rupture. A painful, tender mass over the injured kidney is generally present.

Detailed reports of 24 cases treated by the author over a period of 22 years are presented. Eight patients had gunshot wounds and 16 had no external wounds leading to the injured organ. In the latter group, automobile accidents caused only 3 of the injuries, falls were responsible for 10, a crushing injury for one, and convulsive seizures (no external violence) were responsible for 2. Only one death occurred; it was the result of complications following gunshot injury to the duodenum. —*Ray C. Johnston, M.D.*

GENITAL ORGANS

Functional Derangements of the Liver in Prostatic Cancer and Their Role in Prognosis and Treatment of this Disease. ANTONIO PYTEL. *Urologia*, Treviso, 1955, 22: 321.

SEVENTY-TWO CASES of carcinoma of the prostate in various stages of evolution form the material for the present study of complicating derangements of the functional activity of the liver. The detoxifying function was investigated with the hippuric acid test of Quick, and the santonin test of Muchtar and Dzawatt; the protein-forming function was studied by means of the Takata-Ara test and the thymol test, and the carbohydrate metabolism by means of Bauer's test. The titers of bilirubinemia and of urobilinuria were evaluated, and in another group of patients the prothrombin function was examined.

It was observed that in 32 per cent of all cases of prostatic cancer there were present serious disturbances in the function of the liver. These patients showed the clinical symptoms of dyspepsia, headache, dizziness, etc. The most important disturbance of hepatic function was that in its detoxifying action. The carbohydrate metabolism was also disturbed in about one-half the patients in this group, although this failure was not as serious as that of the detoxifying function. The deposition of pigment (bilirubinemia; urobilinuria) was affected in only a few patients, especially in those having bone and visceral metastases and a severe anemia.

Bilateral orchectomy produced positive results in improving the picture presented by the derangements of hepatic functions; less effective in this regard was the treatment with estrogens. With both these therapeutic aids the picture was decidedly improved, but in 32 per cent there was no evidence of restoration, or even improvement of the hepatic picture.

Some improvement could be obtained by the administration of glycine-containing substances and of vitamins C, B_1, PP, and K, but the most important improvement was procured by the system of so-called "passive gymnastics of the liver." This method was proposed by Pribram (*Muench. med. Wschr.*, 1936) as a means of improving the function of the liver and biliary ducts.

The method of Pribram—as modified by the author and associates—consists in periodic stimulation of the assimilative function of the liver, alternating with periods of stimulating the dissimilating processes. The author's method as applied in cases of serious functional derangements of the liver consists in the daily intravenous injection of 20 cubic centimeters of 40 per cent glucose and the subcutaneous injection of 8 units of insulin. These injections are carried on for 2 days and followed by daily intramuscular injections of 1 cubic centimeter of a 1 per cent solution of thyroxin for two days. An average course of treatment has consisted of 10 injections of insulin with glucose and 10 injections of thyroxin. After 12 days of such treatment there is added a daily injection of estrogen. This combination forms a favorable milieu for the successful estrogenic treatment of cancer of the prostate.

With the treatment described, the author has been able to secure marked improvement in bedridden patients, even restoring some of them to active employment. Estrogenic therapy and orchectomy alone have not produced such results in this grave disease.

Finally, it is asserted that the degree and character of the functional derangements of the liver may have a certain prognostic significance in severe cases of cancer of the prostate. —*John W. Brennan, M.D.*

The Treatment of Carcinoma of the Prostate (La terapia del carcinoma della prostata). FRANCO DE GIRONCOLI. *Urologia*, Treviso, 1955, 22: 326.

THE AUTHOR'S MATERIAL consisted of 495 cases of prostatic cancer in which treatment with estrogens was initiated as soon as the diagnosis was made. Excluded from these figures are 26 cases in which radical surgery was done; the remaining 469 cases all represented carcinomatous processes in an advanced stage. Included are instances in which the neoplastic tissues had become firmly adherent to the pelvic girdle or had protruded towards the rectum. In many of the patients there were present subjective and objective signs of metastases.

At first the estrogens were given in rather small doses, but these dosages were increased progressively until 50 mgm. per day were being administered. Later an orchectomy was performed, and estrogen therapy in fractional doses, usually given orally, was then continued on a maintenance basis.

At present, 50 mgm. doses of estrogen are given daily for three or four days; then a subcapsular orchectomy is carried out. With this regimen the best results have been procured, and a survival of three years in 57 per cent of the patients in the last series is reported. It must be noted that all these patients were in optimal physical condition, and none was found to have any signs of metastases.

In those cases in which there persisted difficulties of urination despite hormone therapy and which could not be relieved by permanent catheterization, a transurethral electroresection was performed. The results were universally satisfactory with regard to urination, and the operation permitted securing a specimen for biopsy and gaining a clear view of the region of the posterior urethra and neck of the bladder. With such a biopsy a negative finding, however, would not change the original diagnosis of neoplasm.

In a few instances in which electroresection was not possible, either because of local conditions or because of the general condition of the patient, cystostomy was done. In a few instances in which especially advantageous conditions made a transvesical prostatectomy possible the results obtained were of noteworthy advantage.

In operatively treated patients estrogen therapy was carried out also, and since the results have been encouraging, the author has begun to give estrogens to patients with less advanced lesions which are not immediately operable, in the hope of rendering them operable. Nevertheless he believes that the claim of Gutierrez, that with estrogen treatment 70 per cent of such patients can be brought to a state where they can be operated upon, is based on false assumptions.

All in all, the combined method of hormone therapy followed by radical operation, and a continuance of hormone therapy after operation is gaining ground.

In conclusion the author asserts that the hormone therapy of cancer of the prostate should be regarded as the method of choice, surgery being placed in the category of a valuable accessory treatment. In those patients who are resistant to hormone therapy, surgery can at best be regarded only as a palliative procedure.

The tendency to apply hormone therapy earlier in cases of cancer of the prostate gland emphasizes the importance of an even earlier diagnosis. The author urges his colleagues to spare no effort in the attempt to devise other means of recognizing the beginning of this serious disease. —*John W. Brennan, M.D.*

Juxtasphincteric Ischiorectal Prostatic Adenomectomy (La adenomectomia prostatica isquiorectal yuxtaesfinteriana). EDUARDO GARCIA ORTEGA. *Rev. argent. urol.*, 1955, 24: 301.

SEVENTY-SEVEN PROSTATECTOMIES were carried out by the author's method during the years 1952 (September) to 1954 (August). The results obtained provide the material for this report.

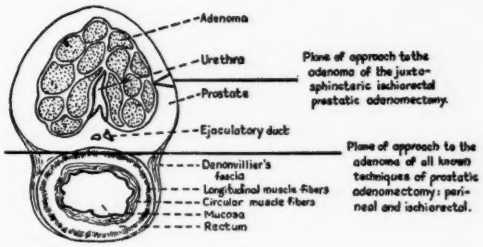


FIG. 1 (Ortega).

The operation consists essentially of an incision in the anterior segment of the ischiorectal fossa, starting at the midline (perineal raphe) on the left side and extending backward and laterally to the left side of the anus, but stopping at the level of the transverse superficial muscles of the perineum. The incision stops at this point so as to avoid injury to the vessels and nerves located posterior to this point. This incision does not differ much from that described by Gil Vernet in his text book *Biología y Patología de la Próstata* (Vol. I, Book 2. Edit. Paz Montalvo, 1953), and for this reason he does not change Gil Vernet's designation for the operative incision.

With blunt dissection the incision is deepened until the dissecting finger contacts the lateral edge of the prostatic capsule. Here the levator ani muscle is pushed laterally and the lateral surface of the prostatic capsule is exposed. Running obliquely across this surface is an important vasculonervous bundle which it is important to avoid; this is done by keeping anterior to this structure. The incision is thus made anterior and almost parallel to this bundle, that is, running even more obliquely than the skin incision (from anteriorly and medially to posteriorly and laterally).

Through the afore-described incision the digital enucleation of the prostatic lobes is performed, the adenomatous mass being first loosed from the union with the membranous urethra and lastly from the prostatovesical union. If the adenoma is large it is well not to use retractors but to grasp the adenomatous mass with the forceps of Oviatt.

Following the enucleation the juxtavesical capsular edge is sutured to the tissues at the proximal end of the membranous urethra, which tends to obliterate the dead space left by the enucleation. The capsule is then sutured and the external or perineal wound closed. A Penrose drain is left in the ischiorectal fossa. An in-dwelling catheter is inserted and left in place for about 8 days.

A schematic figure (Fig. 1) shows how the plane of approach to the adenoma differs from all other known techniques. With this approach through the left ischiorectal fossa and the lateral wall of the capsule the intervention is not a bloody one, and the study of the tabulated statistics show that it leads to a lower incidence of important complications of the adenectomy operation than other methods. Even the complications, such as incompetence of the sphincter and postoperative sexual impotence, which are generally

associated particularly with the perineal route are of singularly low incidence. The most serious general complication is perhaps the injury to the rectum (this occurred in 2 of the author's patients); however, with this technique the operation should be halted, the wound closed, and the adenomectomy carried out immediately through an identical incision on the right side. —*John W. Brennan, M.D.*

Transposition of the Cord in the Surgical Treatment of Varicocele in the Human (Trasposizione del cordone o funicolo spermatico nel trattamento chirurgico del varicocele nell'uomo). GIOVANNI MARIA GIULIANI. *Arch. ital. chir.*, 1955, 79: 51.

TWENTY-TWO PATIENTS with varicocele have been operated upon by the author's method in the past 5 years. These operations have been carried out in the various hospitals in Genoa, Italy (Andrea Gallino, San Giovanni Battista, San Martino) with which the author has been associated.

The technique of the operation consists of an incision over the inguinal ligament, as in a hernia operation, with exposure of the inguinal canal. The testis is freed, the gubernaculum cut, and the organ drawn into the inguinal canal. The skin and subcutaneous tissues at the medial side of the incision are lifted and freed as far as the umbilicopubic line. At the lower end of this line the aponeurosis of the two rectus muscles is incised and these muscles separated. The posterior wall of the inguinal canal is incised and the peritoneal layer separated from the anterior abdominal wall by blunt dissection as far as the midline incision. Pushing the finger through this last incision the fascia transversalis is pushed forward and incised at this point. A long curved forceps is then introduced through the canal just formed, emerging from the inguinal incision. The forceps grasps the gubernaculum of the mobilized testis and draws it through the midline opening. In these manipulations the vas deferens is kept on the medial side of the funiculus to avoid its torsion or kinking. The skin and subcutaneous tissues are undermined from the pubic region into the scrotum to permit the testis to be brought down into the upper part of the scrotum and suspended there without pressure or torsion, so as not to interfere with the vascular supply of the organ and not hinder the act of ejaculation. Closure of the incision is carried out in much the same manner as for hernia operations.

Of the 22 patients operated upon none complains any longer of symptoms; they have been freed from the previous sensations of drawing and tension and from the pains arising with penile erection and the ejaculatory act.

The only complications have been the development of hematomas in the posterior wall of the inguinal canal in three instances. The author thinks that this bleeding has arisen from the rupture of a small artery during the tunneling (the author objects to the word tunnel) or burrowing procedure between the peritoneum and the anterior abdominal wall. This step in the technique is now started at the external orifice of the inguinal canal, far from any branches of the epigastric vessels.

The article is accompanied by schematic drawings of each step of the operation and photographs of cured patients, some of them for as long as 4 years after the operation. —*John W. Brennan, M.D.*

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Some Observations on the Osteitis Deformans of Paget. WALTER MERCER and ROBERT B. DUTHIE. *J. R. Coll. Surgeons Edinburgh*, 1955, 1: 58.

RECENTLY, the two authors of this interesting and informative article had occasion to study a case of Paget's disease with the use of radioactive isotopes. This was the reason for their complete review of the whole problem of Paget's disease. The authors write that Paget's disease or osteitis deformans is slightly more common in men than in women and that it usually presents itself in late middle age, although when first seen it may have been present for many years.

Oftentimes, the discovery of Paget's disease occurs incidental to examination conducted to rule out other disease, and it has been said that in more than 60 per cent of cases, Paget's disease of the ilium is discovered in a routine intravenous pyelogram. Pain is the leading symptom of osteitis deformans; it occurs in 30 per cent of the patients. This pain usually is described as being ill-defined and aching, difficult to localize, and it may occasionally become acute and well defined in the event of sarcomatous degeneration or pathologic fracture. Headache seems a relatively common complaint. In 10 per cent of the patients there are visual or auditory disturbances which occur secondary to cranial nerve compression.

Three well defined pathologic stages of osteitis deformans have been described by Knaggs. The first is a vascular or absorption stage in which the cortex of the affected bone is replaced by vascular granulation tissue. Deformity is most likely to occur in this stage. The second is a stage of advancing sclerosis in which spongy bone is formed over the affected area, and the cortex of the bone becomes markedly thickened. The final stage is one of complete re-ossification in which the deposition of calcium salts in the deformed bone is increased, and the bone becomes markedly thickened and sclerotic.

Radiologically, Paget's disease may present four fairly typical pictures and these are as follows: (1) thickening, broadening, and elongation of the cortex, (2) modification of the trabecular pattern of the cortex, (3) increased transparency of the bone, and (4) increased density of the bone. Biochemically, there is great activity in both calcium and phosphorus metabolism in patients with Paget's disease, and the values for alkaline phosphatase in the serum may be as much as 20 to 30 times normal. However, the equilibrium between the calcium and phosphorus circulating in the serum has always been maintained normally in patients with Paget's disease. There is an increased excretion of calcium in the urine, and calcium may be deposited in the arterial wall or in the interventricular septum of the heart.

Generalized chondrodystrophy and osteodystrophy, hyperparathyroidism, multiple myelomatosis, eosinophilic granulomas, and malignant metastasis from carcinoma of the prostate gland or breast must be considered in the differential diagnosis of Paget's disease. In most instances the high content of alkaline phosphatase in the serum will help greatly in distinguishing Paget's disease.

Paget's disease has been associated with cardiac failure in chronic heart disease, and one of the patients whose case is discussed in this paper had such a change. It is believed to be due to multiple tiny arteriovenous fistulas throughout the bones involved by Paget's disease.

An opportunity of confirming the vascular changes present in Paget's disease was presented to the two authors by a patient who had to undergo reoperation for Paget's disease. Radioactive phosphorus was injected 1 hour prior to operation, and then multiple specimens of normal bone and bone involved with Paget's disease were taken for biopsy. This use of a radioactive isotope demonstrated clearly that the vascularity of bone involved by Paget's disease is more than twice that of normal bone, and served to confirm earlier investigations that there is more blood in bone involved by Paget's disease than in normal bone.

The authors are unable to give an exact cause for Paget's disease. The cause certainly is not an inflammatory process nor is it an endocrine imbalance or disturbance of mineral metabolism. The authors feel that Brailsford's attitude that the disease is a primary, localized, vascular disturbance with a secondary adverse effect on the bone cannot be reputed.

Complications discussed by the authors are: auditory and visual disturbances in 26 per cent of cases, pathologic fractures in 20 per cent, and sarcomatous degeneration in 2 per cent. As far as treatment is concerned, the authors suggest the use of intramedullary or internal fixation for the pathologic fractures, to allow early ambulation, and wide resection of any malignant degenerative process noted. They stress the fact that the presence of malignant degeneration is a seriously limiting factor as far as life is concerned. —*E. W. Johnson, Jr., M.D.*

Congenital Absence of the Radius. DANIEL C. RIORDAN. *J. Bone Surg.*, 1955, 37-A: 1129.

CONGENITAL ABSENCE of the radius presents three characteristics: radial deviation of the hand, shortening of the forearm, and generalized underdevelopment of the extremity. There are two main types of the deformity. A little more than 50 per cent of the reported cases had complete absence of the radius. The remainder had only partial absence, most commonly of the distal end. Absence of the diaphysis or proximal end was not observed by the author.

Associated deformities include harelip, cleft palate, clubfoot, hydrocephalus, hernia, kyphosis, scoliosis, torticollis, rib deformities, reduction in size of the scapula and clavicle, and shortening of the humerus. Some carpal bones are normally absent. The navicu-

lar bone is most frequently absent, with the greater multangular next. The thumb and first metacarpal are usually absent. Either may be present in the absence of the other. Muscle changes include absence of the pectoralis major, absence of the biceps, or abnormal insertion of the biceps into the lacertus fibrosus in cases of complete absence of the radius. The brachioradialis may be absent or insert into the ulna. The radial wrist extensors may be absent or fused with the common extensor of the fingers. The thumb extensors are absent if the first metacarpal is absent. The radial artery is frequently absent and the radial nerve may terminate at the elbow.

Fanconi's syndrome may be present in patients with absence of the radius. In the one case seen by the author the patient was not operated upon and died about a year later. The embryology of this condition is not clear. Two theories are advanced: the archipterygial theory of Gegenbaur and the maternal nutritional deficiency theory.

Congenital absence of the radius was reported as early as 1733. If the author's cases are included, there are now 274 cases reported in the literature. In most of the cases reported in the literature the patients were treated in late childhood or early adult life. The author believes that treatment should be instituted as early in life as possible. In one case he began treating the child when it was 10 days old.

There are three objectives in the treatment of this condition: correction of the marked radial deviation of the hand, improvement of the function of the hand, and the promotion of growth. The author uses a method similar to that proposed by Starr. There are differences, however, which the author feels are very important. He emphasizes that nonoperative measures must precede surgery. By the use of casts, splints, and braces he corrects the soft tissue deformity to the maximum possible degree, before beginning the operative treatment. The second step is the one which differs from previously described methods of treatment. In this step a surgical release of the carpus is performed. The carpus and hand are thus placed over the end of the ulna. It was not necessary to perform tenotomy on any of the patients in this series. The position of the hand and carpus is then maintained by Kirschner wires and casts. It is not possible to obtain this position with nonoperative measures, and it must be obtained before the substitute radius is inserted.

In the next step osteotomy of the bowed ulna is carried out. This is done only if the ulnar bowing is marked and produces considerable deformity per se. Finally, a graft is transferred to replace the absent distal radius. The graft consists of the head and a portion of the shaft of the fibula, together with the proximal fibular epiphysis. The length of the shaft which is removed varies with the age of the child. The shaft of the fibula is obliquely placed against the shaft of the ulna. Either a V-shaped wedge of ulna is turned down and the fibula wedged into this, or an osteotomy of the ulna is performed and the fibula is placed against the raw surface. The graft must be firmly fixed to the ulna or it may absorb. In this series, growth at the epiphysis did not occur, but increase in length was observed. Apparently, this was due to ossification of the epiphysis.

The author has observed 11 patients with this condition. One died of an associated condition, 2 were lost to follow-up, and 2 are very recent cases. The remaining 6 cases are reported in detail. In 2 there was absence of the distal radius and in 4 there was complete absence of the radius. After treatment there was an improvement in the appearance, motion, and strength of the hand in all of the cases. A thumb was constructed from a deformed index finger in one case. The author believes that a thumb should not be constructed in patients who have a unilateral deformity and should be constructed on only one side in patients who have a bilateral deformity.

—*Robert D. Larsen, M.D.*

Bilateral Cystic Dystrophy of the Os Lunatum of the Carpal Bones in an Instance of Osteopoikilosisi Anomalous Morphology of the Osteopoikilotc; Opacity? (Distrofia cistica bilaterale del semilunare del carpo in un caso di osteopecilia; morfologia anomala della chiazza osteopecilica)? G. Scarfì and A. Pròclémer. *Chir. org. movim.*, 1955, 42: 80.

The patient whose case is here reported was a 30 year old workman whose bone condition was discovered fortuitously on the occasion of a roentgen examination. The rounded or elongated, and at times confluent opacities were bilaterally and more or less symmetrically placed in the epiphysial and metaphysial regions of the knee, ankle, and hip. In the lower extremities the long axes of the shadows, or spots, were typically directed along the lines of force. In the skeletal regions of the shoulder on the left side there were also opacities; here sclerotic-appearing flecks were mainly present in the region of the anatomical neck; however, at the junction of the neck with the head of the humerus there was a classical annular shadow consisting of a band of shadow following the periphery of the bone and encircling a center of lessened opacity.

Both wrists were especially interesting in that in addition to the classical spots in the lower ends of the radius and ulna, in the carpal bones, and in the proximal ends of the metacarpals, there was exhibited in the two lunar bones a peculiar square or oblong spot of decreased opacity, resembling rather strikingly the cysts of dysplasia fibrosa polyostotica; in other words, they suggested a translucent jewel with a surrounding sclerotic border. The skeletal lesions are shown in the original text in a series of roentgenograms.

The authors do not discuss the classic nosology of this disease, but merely remark that the course of the anomaly had been absolutely without characteristic symptoms and that there was no evidence of hereditary taint in the patient's family.

Finally, the various theories of pathogenesis were discussed. The authors themselves tend to consider the agency of a mesenchymal hereditary predisposition eventuating, on the one hand, in the production of the sclerotic areas, and, on the other hand, giving the impetus of the formation of the cystlike appearance in the semilunar bones to a circulatory deficiency, in view of the well known instability of the blood supply to this bone. Indeed, they consider that the sclerotic lesions and the cystlike lesions may be entirely independent of one another in the nosologic sense.

—*John W. Brennan, M.D.*

The Cysts of Osteoarthritis of the Hip; a Radiologic and Pathologic Study. K. RHANEY and D. W. LAMB. *J. Bone Surg.*, 1955, 37-B: 663.

THE AUTHORS have studied the excised femoral heads in 36 patients with advanced osteoarthritis of the hip, and 14 other femoral heads excised for the treatment of fracture of the neck of the femur. These were studied grossly, radiographically in the gross specimen, radiographically in slices, and microscopically.

The authors point out that the existing changes found actually on serial sections are much greater than one would expect from examination of the radiograph in an intact femoral head. The extent of each cyst is also greater. They believe that the cysts are the result of repeated trauma to the articular surface. The cartilage is first destroyed, and this is followed by destruction of the subchondral plate and the production of minute fractures in the subjacent trabeculae. Various stages of repair can be found in such a femoral head. There is usually some attempt at repair of the fractured trabeculae. Various stages of bone repair may be seen in the sections. In some cases, instead of new bone, masses of cartilage may form by a process of metaplasia and some is converted into scar tissue. Later, apparently, the synovial fluid enters the bony defects through a breach in the articular surface. The authors do not believe that it is the pressure of fluid that is primarily responsible for the formation of the cyst, but rather that these areas of bone necrosis are formed and later are filled passively with the synovial fluid. —*Edgar L. Ralston, M.D.*

The Diagnostic Criteria of Fibular Collateral Sprain of the Ankle. MARSHALL K. STEELE, JR. *U. S. Armed Forces M. J.*, 1955, 6: 1752.

THE AUTHOR'S PURPOSE in this concise article is to illustrate the complications associated with, and disability arising from, the average sprained ankle. Various authors have written that complete rupture of the ligaments on the lateral aspect of the ankle occurs in approximately 50 per cent of the so-called simple sprains.

The author adequately discusses the literature as well as the various diagnostic criteria necessary for the diagnosis of partial or complete rupture of the collateral ligaments on the fibular side of the ankle. He stresses the importance of making roentgenograms with the ankle held in forced inversion and plantar flexion, to demonstrate any tilt of the talus which would occur after complete rupture of the ligaments.

In the author's experience, if severe pain is present, forced inversion and plantar flexion of the ankle can be accomplished (for roentgenograms) after peroneal nerve block, and no other anesthesia will be necessary. In 33 per cent of sprains of the ankle without fracture seen during a period of 2 years, severe talar tilt was present, a fact which certainly emphasizes the importance of making roentgenograms with the ankle in marked inversion and plantar flexion. Many writers have recommended immediate surgical treatment of complete rupture of the ligaments, but in the author's experience plaster immobilization for 3 to 6 weeks in a short-leg walking cast, followed by peroneal exercises and a lateral heel wedge, has been absolutely adequate. He recommends that the ankle be treated by rest in bed, elevation, use of an ice bag and immobilization, with the application of a short-leg walking cast when the swelling has subsided.

When simple sprains occur, in which no massive ligamentous rupture can be demonstrated by tilting roentgenograms, the author suggests that the leg be treated by elevation and support, that active motion be permitted on the second day, and ambulation from the third to the sixth day, with full return to activity by the tenth day after injury.

For two of his patients whose condition was followed for some time, and who were thought to have had inadequate primary treatment, it was necessary to do a Watson-Jones type of tenodesis 1 year and 2 years after the date of injury, respectively.

—*E. W. Johnson, Jr., M.D.*

The Etiology and Pathogenesis of Achillodynia (Die Aetiologie und Pathogenese der Achillodynie). HANNES SCHNEIDER and P. F. GRILLI. *Zschr. Orthop.*, 1955, 86: 595.

THE ETIOLOGY of the Achilles tendon pain is discussed. Sixty tendons of 30 people 50 years old and up were examined and the relationships between the histological and clinical findings were correlated. In all of the tendons there were minimal degenerative changes consisting of the deposition of lipoid material, fragmentation, focal necrosis, and hyalin degeneration. It is interesting to note that in no case was periosteum found at the insertion of the tendon on the calcaneus. The tendon was directly anchored to the bone and in a few instances by means of a cartilaginous plate. Because of this, such terms as periostitis or peritendinitis were not justified. If pain is present over the Achilles tendon and x-ray examination shows calcific deposits within the tendon, local ossification, or calcaneal spur, these changes should not be considered responsible for the symptoms. Rather, chronic decompensation of the tendon due to small traumas should be considered. The most frequent factors in the authors' cases were poorly fitting shoes and overstress.

It was also apparent that it was very difficult to evaluate the presence of chronic apophysitis in adolescent patients, since roentgenographs taken of normal feet showed many normal variations in the appearance of the apophysis. The authors believe that in many such cases in which apophysitis is suspected, pain may occur because of chronic insufficiency of the tendon resulting from overstress.

In contradistinction, acute inflammatory signs such as redness or heat should be designated as "tendonitis." If, however, the same changes are localized over the subcutaneous or subtendinous bursae, the term "bursitis" is justified.

Clinically, the patients in the largest group were between 20 and 30 years of age. In many of these patients poor shoes were directly responsible for the symptoms. The second largest group consisted of patients 60 years of age and older. In most of these the pain was thought to be due to degenerative changes in the tendon.

In conclusion, the authors state that Achilles tendon pain is due to changes following overuse of the tendon and its environment when specific inflamma-

tion is excluded. Because of this, they believe that for this condition such terms as achillodynia or tendopathy should be used. —*George Wichman, M.D.*

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Indications for the Operative Treatment of Tendinitis Calcarea. PEHR MALM. *Acta chir. scand.*, 1955, 109: 442.

CALCIFICATION of tendons and ligaments is a familiar lesion to almost all surgeons. De Palma writes that roentgenologic examination disclosed calcification in the shoulder area in 43 per cent of a series of 300 painful shoulders. Calcification may occur in any tendon, but by far the most common site is the musculotendinous cuff of the shoulder. The region of the greater trochanter is the next most common site, followed in turn by the elbow, fingers, and the knee joint. A variety of names are used in the literature to describe the presence of calcification in the tendon, but the author suggests and recommends the term "tendinitis calcarea."

The author believes that these calcium deposits result from repeated trauma, with superimposed degenerative changes to which the body reacts by depositing amorphous calcium carbonate and phosphate in the tissues involved. This calcification may be present with or without symptoms; if symptoms are present, they consist of tenderness on palpation, pain, and limitation of motion. These symptoms may be chronic, or they may be subacute or acute. Occasionally excessive strain, slight trauma, or a succession of stereotyped movements may change chronic or asymptomatic deposition of calcium to an acute form in only a few hours. The author cites one series in which the condition of 20 patients was followed for 5 years during which latent, symptom-free tendinitis calcarea existed. It was noted that after varying periods of time, symptoms developed more or less suddenly in 12 of these patients; sometimes the symptoms followed trauma. When the condition is chronic, the calcareous deposit has been likened to dry, white, powdered chalk. With the advent of an acute stage, however, it is thought that edema develops in the calcium deposit, thus producing increased pressure from this deposit, resulting in the patient's acute symptoms.

The conservative treatment of these conditions is discussed by the author, and he mentions heat, rest, gentle exercise, immobilization in a plaster cast, irradiation, and extensive sedation. However, he believes that the only efficient treatment for such deposition of calcium is to perforate the wall of the calcium focus so that the mass can be dissipated into the surrounding tissues or into the neighboring joint. He speculates that multiple-puncture wounds of the calcium focus, by a needle, may ultimately effect dissolution of the calcium, but that if pain is severe, surgical excision of the mass is far more desirable and gives instantaneous relief.

In conclusion, he cites 3 cases of chronic tendinitis calcarea and 4 cases of acute tendinitis calcarea to illustrate his point. The author firmly believes that when the condition is acute, relief is dramatic after incision and evacuation of the deposit of calcium.

—*E. W. Johnson, Jr., M.D.*

Cancellous Bone Grafts of Resected Tuberculous Joints in the Upper Extremity (Die Spongiosaplombierung resezierter tuberkuloeser Gelenke an der oberen Extremitaet). HANNS LERCH. *Zschr. Orthop.*, 1955, 87: 7.

FIFTEEN CASES of tuberculous lesions involving the joints of the upper extremities are presented. The lesions were operated on and the cases were followed up by the author since 1951. In each case complete excision of pathologically involved tissue was done and the resultant bony defect was filled in with cancellous bone chips mixed with bacteriostatic medication. In many cases larger cortical bone grafts were used for greater stability. They were obtained from the patients' own tibias or from a bonebank.

Of 7 cases in which the carpal joints were involved one was complicated by tuberculous infection of the tendon and in another, minimal wound dehiscence occurred. Five of the wounds healed up without complication within a 4 month period. Of 3 patients on whom elbow fusion was done, one developed wound dehiscence and one developed pseudarthrosis. Healing occurred under conservative treatment. Of 5 patients with shoulder fusion all had satisfactory end results and were asymptomatic 4 months after surgery.

—*George Wichman, M.D.*

Arthrodesis of the Wrist Joint (L'artrodesi del polso). GIUSEPPE MASTANDREA and LAMBERTO PERUGIA. *Ortop. traumat. app. motore*, 1955, 4: 997.

THIRTY-NINE WRIST ARTHRODESES, performed during the past 15 years at the Institute of clinical orthopedics and traumatology of the University of Rome, Italy are reported. This material included 21 spastic paralyses, 13 flaccid paralyses, 3 congenital obstetrical paralyses, and 2 post-traumatic paralyses.

The purpose of operative interference was to increase the gripping function of the hand. There were no cases of wrist arthrodesis for the cure of inflammatory diseases in this material, which objective for operative procedures has been quite prominent in some other statistics. At the authors' institute inflammatory conditions have been rather satisfactorily treated by orthopedic immobilization. In a few instances surgical interference was resorted to for the relief of pain.

The surgical techniques employed were modified to suit the individual condition encountered; however, a general rule has been to use nonsurgical means first with the hope of limiting the sacrifice of bone tissues. Especially in the child, the sacrifice of part of the skeleton might have serious consequences. Because of this consideration attempts were made in subjects under 15 years of age to limit the operation to radionavicular arthrodesis, and retain, insofar as possible, full mobility of the mid-carpal. When additional bracing of the joint is imperative, Marino-Zuco (head of this Institute) prefers to supplement the arthrodesis by the insertion of one or two Kirschner wires. The wire is always inserted into the medulla of the carpal bone (usually the second carpal), passed through the carpal bones, and then into the medullary cavity of the radius.

The Kirschner wire was removed after 1 or 2 weeks; however, the cast immobilization was retained for 4

to 6 months and then an orthopedic appliance was frequently worn for a much longer period, that is, as long as there appeared to be a tendency toward recurrence of the deformity.

In the cases in which additional bracing seemed necessary, this was usually provided by a sliding bone graft, passing from the radius to near the base of the metacarpals; or the graft was transferred from the ulna to the receiving slot in the radius. In 2 instances the graft was procured from the bone bank.

Of course, all possibilities were exhausted in the matter of tendon transplantation and nerve repair; in fact, Volkmann's ischemic contracture, a condition considered by other authors to constitute a proper indication for arthrodesis of the wrist joint, was treated on the authors' service by nonsurgical means. This condition and its treatment have been discussed in a previous publication from this Institute.

The results may be stated in a few words. In considering what was to be expected in the individual condition encountered the results in this material have been satisfactory. —*John W. Brennan, M.D.*

Division of Tibial Collateral Ligament for Removal of the Medial Meniscus. JULIUS S. NEVIASER. *J. Am. M. Ass.*, 1955, 159: 1595.

THE AUTHOR, in 68 patients, divided the tibial collateral ligament to gain access to the medial meniscus in the knee. In 4 patients he divided the fibular collateral ligament for the removal of the lateral meniscus with cyst formation. The technique of the incision is described as is the postoperative care.

The functional results in all cases were assessed as good. The private patients returned to work in 6.2 weeks after surgery and industrial patients returned to work 8.1 weeks after surgery. In 3 patients there was minimal instability of the knee when the knee was flexed to 165 degrees. This disappeared when the quadriceps muscle was contracted. Six patients had demonstrable atrophy of the quadriceps muscle which persisted for 6 months or longer.

The author feels that the advantages of his treatment are: (1) the medial meniscus is completely removed, (2) operative trauma is diminished, (3) any cyst of the meniscus can be removed with the meniscus in one piece, (4) inspection can always be more complete, and (5) subsequent operation for removal of the posterior segment of the meniscus is avoided.

—*Edgar L. Ralston, M.D.*

FRACTURES AND DISLOCATIONS

The Importance of the Muscular Factor in the Process of Consolidation of Bone Fractures (L'importanza del fattore muscolare nel processo di consolidazione delle fratture ossee). FR. SAVERIO DE SAPIA and A. SAVOIA. *Ortop. traumat. app. motore*, 1955, 4: 945.

YOUNG RABBITS of an average body weight of 2 kilograms were used in this study. The femur was exposed from the greater trochanter to the lateral condyle and completely deprived of its muscular attachments. A transverse osteotomy was done with a scalpel and the bone ends inserted into a tubular acrylic prosthesis so as to isolate a large portion of the femoral diaphysis from the surrounding tissues. After periods of 5 to 100 days the animal was sacrificed and histologic and histochemical studies made of the fracture area. For the histologic examinations hematoxylin-eosin was employed. For the histochemical studies the authors used the method of Gomori, based on the action of silver nitrate on the tricalcium phosphate of the bone. This results in the formation of phosphate of silver, which is reduced from sodium hypophosphite, and which gives an intense black coloration of the calcified areas. The tissues were then counter-stained with safranine.

The results of these studies are depicted in a series of photographic reproductions—unfortunately, none of them in color. The present studies show that exclusion of the muscle tissue does not impede the process of repair, but only prolongs it. The authors do not accept unreservedly the conclusions of Cretin (Le trimôme os-muscle-peau. *Praxis*, 1951, 40: 862) that the contiguous muscle tissues are essential to the healing of a fracture in that they act as a temporary reservoir for calcium originating from the initial decalcifying process in the fractured bone ends, and that during the healing process the calcium salts are fed back into the fracture site. Rather, they believe that the prolongation of the healing process in those instances in which the muscular participation is excluded is caused by interference with the blood supply to the fracture site, due to the destruction of the musculoperiosteal vascular network.

The authors consider that the process of repair is a participation of all the tissues in a harmonious whole, and it is only in this sense that the muscle tissue aids in the formation of bone callus, and that the exclusion of the muscular factor disturbs the normal process of callus formation. The muscular tissues are to be regarded as a necessary, but not as an indispensable, factor in consolidation of osseous fractures.

—*John W. Brennan, M.D.*

Fatigue Fractures of the Ulna. DAVID L. EVANS. *J. Bone Surg.*, 1955, 37-B: 618.

THE AUTHOR reports 2 cases of fatigue fracture of the ulna. In the first case, the history suggested that it had been present a year prior to his examination. The patient had been doing heavy farm work after he had sustained a fracture of his ulna. Roentgenographic examination disclosed a pseudarthrosis at the midshaft of the ulna with considerable new bone formation about it. A bone graft procedure was carried out with eventual union across the site of fracture.

The second case described was that of a cook. This fracture was discovered apparently one week after the injury and was successfully treated with plaster immobilization. —*Edgar L. Ralston, M.D.*

The Treatment of Fractures and Pseudarthrosis of the Scaphoid with Central Grafting; Autogenous Bone Peg. IVAR PALMER and ANDERS WIDEN. *Acta chir. scand.*, 1955, 110: 206.

IN 1942 PALMER presented a summary of the then current methods of treatment of fractures of the scaphoid; however, his concepts of treatment of these lesions has changed since that time and this is the reason for the present article.

In the treatment of fresh isolated fractures of the scaphoid good fixation over an adequate period of

time (roentgenographically determined) commonly leads to healing. In luxation fractures of the wrist in which the scaphoid is fractured the instability of the fracture is very great; the authors think that open surgical treatment should always be employed for these fresh lesions.

Cases of neglected scaphoid fractures will always be found. These neglected cases always present disturbances of healing. The bone shows a picture either of delayed union with pathologically increased processes of resorption in the fracture zone or of a manifest pseudarthrosis. The cases with avascular necrosis of the proximal fragment will usually consolidate with external fixation for an extremely long time; the patient often gives up and returns later with a pseudarthrosis.

The authors briefly describe several methods of treating the pseudarthrosis.

1. Extirpation of fragments or of the entire scaphoid. The senior author has tried this method in 10 cases, but does not think that the results are encouraging.

2. Interposition of a strip of adipose tissue between the pseudarthrosis fragments. This method may be useful in pseudarthroses with very small distal fragments.

3. Methods for production of healing of the pseudarthrosis. (a) Scraping out and transplantation of cancellous bone; the authors feel this method will not lead to success very often. (b) Drilling according to Beck; most writers report poor results using this method. (c) Osteosynthesis with metal pins; moderately good results may be obtained. (d) Grafting with a central bone peg as first described by Adams and Leonard in 1928. The writers think that this is the method of choice for treating scaphoid pseudarthrosis and fresh unstable (luxation) fractures of the scaphoid.

The authors describe their detailed technique of drilling along the long axis of the bone with a 3 millimeter drill and inserting a tightly fitting bone peg from the tibial crest. A plaster cast must be worn until the roentgenogram shows bony consolidation. A total of 28 cases are presented. On roentgenography 20 patients showed typical pseudarthroses and came to operation from one-half to 12 years from the time of trauma. Bony consolidation occurred in all these cases and only 2 patients still have complaints, but they both had arthrosis of the wrist prior to operation. Six patients had delayed union (2 to 4 months following injury); all 6 achieved bony consolidation following the operation. Two patients had unstable fractures and were treated primarily by operation; both healed.

Thus, this series shows healing with bony consolidation in 100 per cent of the cases (28) following operative treatment with autogenous bone peg.

—*Bernard C. Gerber, M.D.*

ORTHOPEDICS IN GENERAL

The Fracture Callus in Childhood and in Senescence (Il callo di frattura nel bambino e nel vecchio). R. Zanoli and I. F. Goidanich. *Chir. org. movim.*, 1955, 42: 87.

This report is primarily statistical, although it was completed by an experimental study in an attempt to clarify some of the differences encountered in the human material. This human or clinicostatistical material was selected from that furnished by the Rizzoli Institute, University of Bologna, Italy, and was chosen with the purpose of exemplifying the differences to be observed in the healing of fractures in the very young as distinguished from that in the very old. This study shows in essence that there is a notable delay in the healing in senescence.

This delay in healing in the elderly was found to be accompanied by a markedly delayed and faulty development of the callus. However, this meager development of callus in the aged was not the only way in which the fracture healing in the older patient differed from that in the young. In the young patient the fracture was found to heal by way of a direct metaplasia of the cells of the muscular interstitia to form an embryonic type of connective tissue which invaded the primary hematoma and gave off the fundamental substance (preosseous substance of Leriche and Policard). The bone salts (calcium, phosphorus) were then deposited in this fundamental substance.

In the older individual, on the other hand, this direct process of ossification was not pronounced. There was rather an indirect type of ossification consisting of the development of large areas of chondroid material in the form of chondroid trabeculae and considerable areas of true cartilage formation which is so characteristic of the healing of fractures in the animal. The chondroid and cartilagenous trabeculae were then secondarily transformed by a chondroclastic activity of the embryonic tissue into ossifiable chondroid trabeculae. In other words, the healing of the fracture in the very young consisted of a purely osteoid process by way of the preosseous substance, while that in the aged consisted of a cartilaginous form of bone healing by way of the fundamental substance (mucoprotein) of the cartilage.

In an attempt to cast some light on these discrepancies the authors carried out studies on the fracture healing process on the human material (in those instances in which the fracture bed was exposed surgically) and on animals (rabbits) by means of the new stains (Hotchkiss, MacManus, Von Kossa, Schiff), which are considered to show the results of enzymatic activity in the healing tissues.

From these studies the authors conclude that the process of ossification in general and the formation of the callus in particular are chiefly, if not exclusively, enzymatic processes. Thus, they believe that the differences in the course of bone healing in fractures in the very young and in the very old are conditioned by differences in the activities of these enzymes. The delay in healing in senescence can thus be ascribed to a sort of impoverishment of enzyme production, and to the fact that this impoverishment may in turn be ascribed to a diminished metabolic capacity of the body cells in senescence.

The only matter which the authors think they are justified to consider new is that of the behavior of the hematoma in its second phase, that is, the manner of its organization. The periosteum in the initial phase of the organization is absolutely inert, exhibiting merely a phenomenon of regression at the level of the

osseous fragments of the fracture with general and lacunar types of resorption. The theory that the invasion of the hematoma (organization) is effected by the young connective tissue elements is certainly not a new conception; however, the fact that these invading cells arise also from the sarcoplasm and from the sarcolemma has been demonstrated definitely. The tissue-staining methods here employed are considered to be original.

—*John W. Brennan, M.D.*

The Process of Repair "in Vitro" of Fractures of the Embryonic Bone (Il processo di riparazione "in vitro" delle fratture di ossa embrionali). G. GOGLIA and FR. SAVERIO DE SAPIA. *Ortop. traumat. app. motore*, 1955, 4: 963.

CHICK EMBRYOS at various periods of incubation of the egg formed the experimental material for this article of research. Bones, or osseous primordia, of the embryonic chicken leg were obtained by means of a cataract knife and then cultivated in vitro.

The specimens were grown in chicken plasma from year old birds. The plasma was renewed every 15 days. The phosphatase was prepared according to the method of Pannet and Compton, fresh for each experiment.

The cellular elements of the tissue sections were cut without decalcification procedures and stained by the methods of Mann and of Hotchkiss and MacManus. The already deposited bone tissue was distinguished from that developing under the influence of the phosphatase enzyme by the cobalt method of Christophe and that of Bourne. A series of histologic photographic reproductions accompany the text of the original article.

The authors' studies showed in general that the repair of fractures of the embryonic bones occurred completely and rapidly only when the trauma involved a zone of cartilage which was still immature. In the cartilage in the hypertrophic stage of development and in the tissues already ossified the repair was incomplete and took place as a connective tissue callus coming from the periosteum. This failure of the hypertrophied cartilage to heal was ascribed by the authors to the fact that the hypertrophied cartilaginous tissue was ready for the regressive changes incident to the physiologic ossification process and had therefore fulfilled its function, that is, although it was encountered in the embryo it was actually an aged component of the tissues of the organism.

The authors believe that the tendency of the callus to invade the fracture line rather than to develop externally into the surrounding tissues is due to the fact that the deeper, or juxtafractural, layers of the periosteum are more active physiologically than the superficial layers. They do not feel constrained to postulate any influence on this behavior arising from the phosphatase enzyme of the bone tissue itself. In fact, they feel that an influence of the phosphatase enzyme in the healing of these fractures is excluded because ossification did not always occur, even in the presence of an abundance of phosphatase. They do not think that the formation of callus represents an intrinsic property of the bone at all, because under the conditions of their experiments the bone fragments in the process of calcification were never completely restored.

—*John W. Brennan, M.D.*

Treatment of Bone and Joint Tuberculosis Complicated by Pulmonary Lesions (Gleichzeitige Behandlung der mit Skelettherden kombinierten Lungentuberculosen). K. DAUBENSPECK and H. JENTGENS. *Zschr. Orthop.* 1955, 87: 1.

SIX PATIENTS are presented who were seen and treated for active pulmonary tuberculosis. In 5 of the patients tuberculous spondylitis of the lumbar spine was present and in one the right sacroiliac joint was involved. After a short period of treatment and when the patient showed clinical improvement, surgery of the skeletal lesion was performed. The operation consisted of fusion alone or fusion in combination with evacuation of the abscess. All of the patients did very well postoperatively and in no case did dissemination or reactivation of the pulmonary tuberculosis occur. In fact, the authors felt that immobilization of the patients in the cast had favorably influenced the pulmonary healing.

Besides general therapeutic measures, each patient recieved streptomycin, nidrozid, conteben, and parateben in conventional doses. In all of the patients fusion occurred, and they were asymptomatic when discharged.

In conclusion, the authors advise close co-operation of the surgical and medical teams in cases of the type discussed. They feel that early treatment of skeletal lesions greatly shortens the rehabilitation time and the disability of the patients.

—*George Wichman, M.D.*

Physiologic Considerations in Orthopedic Surgery. PAUL C. COLONNA. *Surg. Clin. N. America*, 1955, 35: 1751.

MORE AND MORE PHYSICIANS are coming to appreciate the necessity for knowledge of physiology as it applies to orthopedic surgery. The author's excellent article sustains this attitude and in a general way explains the value of physiology in the understanding of bone problems. He considers, in turn, bony structure, its response to stress, ultrasound, the recent work done by Robinson on the electron microscope, and the study of the crystalline inorganic component of bone with its relationship to the organic matrix of bone. He also uses the physiologic approach to discuss the growth of bone, and from this problem proceeds to a discussion of the shortening and lengthening of bones, epiphysial stimulation and arrest, and other such problems in the discrepancy of length. The final part of this article has to do with bone grafting, and the author presents 6 cases to demonstrate the physiologic principles of bone grafting.

—*E. W. Johnson, Jr., M.D.*

Hydrocortisone Acetate in the Treatment of Dupuytren's Contracture and Allied Conditions. L. ZACHARIAE and F. ZACHARIAE. *Acta chir. scand.*, 1955, 109: 421.

THE AUTHORS REPORT the results of topical injection of hydrocortisone acetate in corresponding series of nonoperative and postoperative cases of Dupuytren's contracture. Most of the patients had instillations of 25 milligrams weekly for 2 to 5 weeks. In the postopera-

tive cases the treatment was not instituted until the wounds had completely healed. The authors point out that the milder cases were treated with hydrocortisone, whereas the long-standing contracted cases were usually treated surgically.

They think that the results are good in early cases or for the relief of pain in the active phase of mild cases. They also believe that surgery is indicated in the long-standing contracted cases and that postoperative instillation of hydrocortisone acetate can be a valuable adjunct in the surgical treatment of Dupuytren's contracture.—*Norman J. Rosenberg, M.D.*

The Prognosis and Treatment of Dupuytren's Contracture. RAOUL TUBIANA. *J. Bone Surg.*, 1955, 37-A: 1155.

THE AUTHOR reports on a series of 100 cases of Dupuytren's contracture studied with regard to etiological factors, the site and degree of the lesions, the choice of treatment, and the prognosis with regard to the histology of the lesions. He describes the technique of aponeurectomy and the subject of skin repair.

He reports the results in 56 cases with a follow-up period of 6 months to 5 years following surgery, and considers that 43 per cent were very good, 34 per cent were good, 20 per cent fair, and 3 per cent poor. In a number of cases the author used controlled hypotension combined with the intermittent use of a tourniquet in order to facilitate a careful hemostasis, reduce the time of tourniquet pressure, and avoid the formation of postoperative hematomas during the application of a pressure dressing, and he states that at the Clinique de Chirurgie Orthopedique et Reparatrice de la Faculte de Paris this technique has been used in more than 500 selected cases without incident. Patients having any form of deficient oxygenation are not proper subjects for controlled hypotension procedures. —*Norman J. Rosenberg, M.D.*

Femoral Neck Changes After Rickets? (Schenkelhalsumbau nach Rachitis?). JOHANN BÖSCH. *Zschr. Orthop.*, 1955, 86: 555.

THE AUTHOR discusses the relationship of rickets in children with congenital dislocated hips complicated by coxa vara. Only roentgenograms taken during the past 4 years were evaluated. In many instances in which rickets was suspected clinically, roentgenograms of other joints were taken and included in this study. When they showed epiphysial changes, these were considered proof of the presence of the disease. For comparison, roentgenograms of normal hips and of hips in 150 children with known rickets were studied. Several typical case histories are presented.

One patient with rickets was treated for congenital dislocated hip in an abduction spica. He developed marked changes of the neck of the femur consistent with coxa vara. From this and similar cases the author concludes that the combination of the trauma of manipulation and rickets may lead to a much greater deformity of the neck of the femur. He points out that rickets is still a very common disease and in the treatment of congenital dislocated hips it should always be considered. This is important because in unrecognized cases subjected to closed reduction and an abduction cast, the end results are very poor.

The roentgen ray signs and differential diagnosis are also included in the discussion.

In reviewing 62 similar operations which were done in the same clinic, the authors did not observe generalized dissemination of infection to the other parts of the body. The advantages of this method are direct removal of the infectious process, localized action of the bacteriostatic drugs, and rapid fusion.

All of the patients were followed up for one or more years. A brief review of the literature and roentgenograms of each typical case are also presented.

—*George Wichman, M.D.*

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

The Present Status of the Surgical Treatment of Aneurysms of the Abdominal Aorta (État actuel du traitement chirurgical des anéurysmes de l'aorte abdominale). CLAUDE A. RICHARD. *Sem. hôp. Paris, Ann. chir.*, 1955, 31: 702.

THIS AUTHOR is reporting on the work being done by Dubost on the surgical service of the Hôpital Broussais, Brussels, Belgium. He regards the methods of surrounding the aneurysmal sac with cellophane or of filling it with wire for passage of an electrical current as merely palliative and only to be resorted to in those cases in which the aneurysmal sac cannot be excised.

Whenever it is possible the author prefers excision of the sac and its substitution by a graft. He considers the ideal graft to be a homograft of the aorta itself, but it is frequently difficult to find a suitable graft. Dubost has been using a knitted nylon tube, of the type employed by DeBakey. The original article shows an aortographic reproduction of an abdominal aneurysm involving the aorta and extending from a level below the renal arteries for a considerable distance along both common iliacs, and an aortographic reproduction of the results obtained by means of excision of the aneurysmal sac and its substitution by a De Bakey nylon graft.

The polyvinyl sponge tube, made of compressed and heat-molded ivalon, which is said not to leak like the knitted tubes; is considered to be a marked improvement, but it is thought that the type of graft employed is not as important as careful surgery in its application.

Dubost's 10 cases include his first patient who was operated upon in 1951 and is now in excellent general condition and able to carry on his work as usual. All have been cases of abdominal aneurysm, arteriosclerotic in origin and all below the level of the renal arteries. The contraindications have been limited to those of age (not more than 70 years) and the general condition of the patient. The global mortality of approximately 30 per cent is diminishing with the improvement in technique and the development of more precise indications.

The reported 60 per cent of excellent results would seem to justify the institution of surgical treatment of a condition which has been so disappointing in its spontaneous evolution and its medical treatment.

—John W. Brennan, M.D.

Physiological and Surgical Problems Involved in the Resection of Aneurysms of the Thoracic Aorta. J. MAXWELL CHAMBERLAIN and PETER PARNASSA. *Angiology*, 1955, 6: 567.

THE AUTHORS present a case of multiple aneurysms of the thoracic aorta in a 63-year-old male. Treatment consisted of resection and homologous graft replacement, and circulatory dynamics were sustained by a heterologous aortic shunt. The problems caused by cross-clamping the aorta were thus avoided. When the aorta is occluded, hypertension develops proximally with great strain on the arterial tree, which, in the presence of arteriosclerosis, may cause vascular accidents; at the same time the myocardium is subjected to increased stress with possible cardiac failure, and when the occlusion is released hypotension with all its dangers may ensue. With use of the method described, these pitfalls are avoided.

In the present case there were four progressively enlarging thoracic aneurysms; three were distal to the left subclavian artery and a smaller one was found proximal to the innominate artery. The shunt was constructed of two 23-centimeter pig aortas sutured together, and then sutured to the aorta at the site of the most proximal aneurysm, the other end 2 centimeters beyond the most distal one. The thoracic aorta and aneurysms were resected, from a point distal to the subclavian artery, to the diaphragm and replaced with a freeze-dried homograft. The shunt, which had been in situ for almost 3 hours, was then removed. Postoperatively the patient had a memory loss for 5 days, presumably due to anoxia, and a vocal cord paralysis. Follow up examination revealed his condition to be satisfactory.

In the discussion, the use of hypothermia to decrease the effects of anoxia is mentioned, and it is suggested that in conjunction with a shunt these may be minimized or eliminated. *—Albert M. Schwartz, M.D.*

The Role of the Venous Circulation in the Treatment of Occlusive Peripheral Arterial Disease. ROY J. POPKIN. *Angiology*, 1955, 6: 513.

MANY APPROACHES have been tried to alter the arterial circulation in occlusive peripheral vascular disease, but little has been done to explore the therapeutic possibilities of the venous system. The author suggests that increasing venous flow may prove a simple and adjunctive method in the treatment of these conditions. The arterial flow is maintained by the pumping action of the heart, peripheral resistance, the quantity of blood in the arterial system, the viscosity of the blood, and the elasticity of the arterial walls. Venous flow is produced by the arterial pressure, contraction of skeletal and intestinal muscles, general muscle tone, respiratory movements, and the force of gravity. Any condition which speeds up the venous flow reduces the resistance in the vascular bed and facilitates feeding from the arterial side.

The venous states which contribute to obstruction of venous return are edema of the lower extremities, varicosities, thrombophlebitis, inadequate exercise of the extremities, lack of muscle tone, and pulmonary emphyema with rigid chest walls, fibrotic pulmonary tissue and limited respiratory excursions. The following measures are recommended to correct these deficiencies: Elastic stockings, bandages, diuretics, low salt and low sodium diet to combat venous stasis; calf muscle exercises; abdominal compression by an abdominal belt; increased respiratory movements; posture

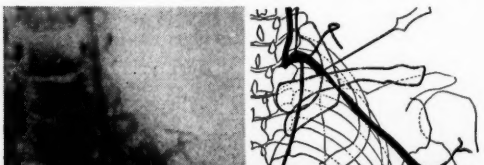


FIG. 1 (Ricklin). Arteriogram. In backward displacement and lowering of the shoulder marked compression of the subclavian artery at the crossing of clavicle and first rib. Reflux of the contrast material into the common carotid and internal mammary arteries.

to offset the effect of gravity, such as use of an oscillating bed, and exercises involving elevation and dependency of the legs. —*Albert M. Schwartz, M.D.*

The Syndrome of Costoclavicular Compression of the Subclavian Artery (Das Syndrom der costoclaviculaeren Kompression der Arteria subclavia). P. RICKLIN. *Helvet. chir. acta*, 1955, 22: 270.

THE AUTHOR, of the Surgical Department of the University of Zurich, Switzerland discusses 4 cases of a little known syndrome caused by compression of the subclavian artery between the clavicle and the first rib. The clinical symptoms are similar to those of the scalenus, or the cervical rib, syndrome: muscular weakness, cyanosis, and pains or paresthesias in the involved extremity with intermittent disappearance of the radial pulse in deep inspiration and in certain positions, especially when the shoulder is drawn backward and downward with the arm hanging straight down. In one case the pains and interruption of the radial pulse occurred in a soldier regularly while standing "at attention", and in another case in a housewife when carrying a heavy shopping bag.

In one of the 4 cases the syndrome was due to a clavicle fracture which had healed in poor position, and in the 3 others to overexertion in persons with weak muscles and poor posture.

In one patient the diagnosis was confirmed by arteriography of the subclavian artery. Whereas in normal position no abnormalities were observed, narrowing of the artery and reflux of the contrast material were seen when the shoulder was pulled back and downward.

Two of the patients were treated surgically. Under the assumption of a scalenus syndrome the scalenus muscle was resected. As operation gave no relief from the pains the hypertrophic callus of the clavicle was resected in one case and the first rib in the other one. Both patients were cured permanently by this intervention. For the other 2 patients gymnastic exercises and correction of posture were sufficient to clear up the condition without surgical intervention.

—*Werner M. Solmitz, M.D.*

Arteriogenesis Induced by Tubes of Plastic Mesh. LOUIS G. HERRMANN and CLAUDE BOLLACK. *Surgery*, 1955, 38: 993.

AUTOGENOUS MATERIALS are most desirable, but no single tissue or sacrificable blood vessel in man has been wholly satisfactory as a replacement for a large artery. Tubes made from peritoneum or fibrous tissue, and even large veins, lack the tough elastic layer of a large artery. Dilatation or degeneration, with eventual occlusion by thrombosis or fibrosis, was the usual end result for such free vascular grafts.

Homologous grafts are used despite the fact that past experience has shown that these fail to retain their original function after transplantation.

Tubes of impervious plastic materials, with and without a lining of autogenous vein, are used to bridge defects in large arteries. These are reasonably successful, and because of their inertness and blood-repellent property, they function with relatively few complications as replacements for segments of large arteries of the neck and extremities.

The authors believe that the replacement of large arteries is a physiologic rather than an anatomic problem. Pervious tubes promote arteriogenesis by supplying an inert, pervious material through and about which the fibroblasts proliferate and form permanent functional layers for the newly formed artery. Such pervious plastic tubes are exemplified by vinyon-N and orlon. These cause autogenesis of arterial coats from fibroblasts and the cloth itself serves as the elastic tissue layer of the newly formed artery.

The authors have shown experimentally that these processes occur. Histologic sections made at intervals of from 2 days to 1 year at the junction of the aorta with the plastic mesh tubes or patches of orlon or vinyon-N mesh have been studied. The plastic mesh tube is quickly covered by a layer of fibrous tissue which is continuous with the adventitia of the aorta. The inside lining of the plastic mesh tube is made up of a thin layer of cells which are of fibroblastic origin. These fibroblasts extend through the meshes of the plastic tube from the outer layers of the artery and the fibrous tissue layer which is continuous with the adventitia of the artery. Within 30 days a well formed layer of fibroblasts lines the entire plastic mesh tube and this layer is continuous with the intimal lining of the aorta above and below the prosthesis. The blood-repellent property of these plastic fibers is probably responsible for the fact that thrombosis does not take place before proliferation of the fibroblasts from the outside of the tube to the inside is complete.

—*Robert Paradny, M.D.*

The Significance of the Terminal Circulation in the Development of Vascular Disease and Disturbances of Blood Flow; Vasographic Studies. E. VOGLER and G. GOLLMANN. *Angiology*, 1955, 6: 540.

PREVIOUS STUDIES have shown that many vascular diseases and disturbances in blood flow originate in the terminal vessels. This paper deals with the changes in these vessels and their effects on other sections of the peripheral circulation. The terminal vessels (arterioles, capillaries, and venules) are situated between the arterial and venous systems, and include the arteriovenous anastomoses which precede the capillaries and can divert blood from the arterial to the venous side, by-passing the capillaries. The method used to study the terminal circulation consisted of percutaneous injection of a water-soluble contrast medium into a branch of a major artery in the extremity, followed by a series of ten roentgen-ray exposures at intervals of 2 to 10 seconds. The solution used was 50 per cent or 70 per cent iodopyracet (drodone); 0.6 of a milligram of hydergine was injected intra-arterially 10 minutes later and the serial vasography was repeated to distinguish between functional, organic, and combined disorders. Normally, during the arterial phase the contrast medium flows from the main branches down through the subdivisions to the terminal vessels where it is not visible to the naked eye but does stain the tissues; it becomes visible again as it reaches the venules and ascends the deep venous system. After the injection of hydergine there is no significant change in blood flow.

Under pathologic conditions, two types of changes are seen, both due to obstruction (constriction) in the arterial section of the terminal vessels; one occurs distal and the other proximal to the sites of origin of the arteriovenous anastomoses.

In type 1 (obstruction distal to arteriovenous anastomoses) there is premature filling of the dilated superficial veins during the arterial phase (when normally the solution should be flowing through the capillaries), as occurs in patients with the "varicose symptom-complex" (ulcus cruris, varicose veins, and stasis dermatosis). This is due to short-circuiting of the blood through the arteriovenous anastomoses. After hydergine the arteriovenous communications become closed and the contrast medium flows through the capillaries, except where pathologic changes have progressed from the functional to the organic stage.

In type 2 (obstruction proximal to the arteriovenous anastomoses) there is marked delay in the passage of the solution through the arterial vessels which results in stasis, venous filling is delayed, and the amount of opaque substance reaching the veins is greatly reduced. The stasis is called "prestenotic stasis." A single intra-arterial injection of hydergine can overcome the obstruction proximal to the anastomoses and restore circulation to normal, providing the disorder is mainly functional. Even if hydergine does not completely overcome the obstruction, blood flow is frequently improved. All obstructions in the arterial section of the terminal vessels, whether proximal or distal to the arteriovenous anastomoses, result in a reduced flow of arterial blood to the capillary bed with insufficient nutrition to the tissues. Changes which cause a marked and abrupt decrease in arterial flow will result in far greater nutritional disorders than changes which are more gradual.

If venous dilatation is still functional, surgical treatment is not necessary, as the condition responds to therapy with hydergine, and this can be demonstrated vasographically. The condition of the veins also depends on the extent to which changes in the walls have caused valvular insufficiency, leading to the formation of a "private circulation" in which, instead of flowing centripetally in the dilated superficial veins, the blood flows centrifugally via the long saphenous vein to the dilated superficial veins and then via the deep veins centripetally, so that part returns via the long saphenous vein; at this stage the process is not reversible. Pathologic changes also affect the vasa vasorum; these may be functional at first, but lead to nutritional disturbances in the vessel wall which eventually become organic. The final form of organic vascular wall changes resulting from the reaction of the body, such as calcification, fibrosis, hyaloiditis, represent a "strengthening" of the damaged vessel walls.

The article is well illustrated with drawings and actual photographs of vasographic studies, and contains an excellent description of the anatomy and physiology of the terminal circulation.

—Albert M. Schwartz, M.D.

Functional Syndromes of the Lower Limb Due to Arteriovenous Communications on the Sole of the Foot (Syndromes fonctionnels du membre inférieur dus aux communications artério-veineuses de la plante du pied). E. MALAN. *Lyon chir.*, 1955, 50: 641.

ACCORDING TO FONTAINE, the derivative arteriovenous canals of Sucquet-Hoyer are not congenital malformations, but normal ubiquitous anatomic elements, more or less developed in different regions. They function when capillary circulation is deficient, as indicated by a very high oxygen content of the venous blood and by small arteriographic images of reversed sparks, and very early filling of the veins during arteriography. Thus Fontaine has introduced a new chapter in vascular pathology, and the author agrees with him that it covers a much vaster field than might be assumed. The present author hopes to demonstrate not only a venous syndrome due to dilatation of arteriovenous communications, but also an arterial syndrome.

On the basis of 9 clinical cases, he demonstrates the possibility of three arterial syndromes due to arteriovenous derivation through dilatation of Sucquet's channels in the sole of the foot. In October 1954, the author reported 3 cases of a functional syndrome of the anterior tibial artery due to a derivation of blood across arteriovenous communications of the heel. Operation was successful in one case. He has now collected 9 cases. Some physiopathologic problems were clarified by a study of 23 cases of arteriovenous fistula (congenital and traumatic). He was able frequently to demonstrate by serial arteriography small affluent arteries of the fistula, and later, in a specimen, to ligate them. Three cases of Klippel-Trenaunay's disease showed characteristic arteriovenous communications in the sole of the foot, similar to those mentioned, and in one case the affluent arteries, springing

from the posterior tibial artery and medial plantar artery, were ligated with good results.

In 6 cases of varices arteriovenous communications, as described by Piulachs and Fontaine, were observed. In 2 patients with classical varices operated upon by saphenectomy, a serial arteriography revealed venous lacunae and characteristic images of fistula in the thigh and leg, explaining the possibility of recurrence and the mode of prevention and treatment. This experience with pathologic vascular manifestations provides a way to interpret certain hitherto inexplicable cases. Many patients complain of pain on walking, which is frequently diffuse and does not stop on standing still, and of sensations of cold varying in degree and localization, occasionally associated with a burning sensation or a feeling of intense heat of the sole of the foot. Nonserial arteriography shows absence of filling of the anterior tibial artery, but serial arteriography will occasionally show a very slow filling. This finding has been interpreted as an arterial spasm with indications for the administration of vasodilating drugs (that usually give no relief) or occasionally ganglionectomy (with little improvement).

Details pertaining to the 9 cases observed by the author are presented. For a time, all patients in whom arteriography revealed arteriovenous communications were repeatedly studied from a physiopathologic standpoint. Interpretations of findings were difficult because the syndrome is variable and there is a different response in repose and during the attack. It is hoped that in the future the physiopathologic findings may confirm the clinical conclusions and explain the manifestations.

Fontaine has reviewed the very fragmentary morphologic facts hitherto available with regard to arteriovenous communications which, in the human body, constitute primarily mechanisms of regulation of arterial debit, as existing in Sucquet's canals or in more complex forms. The study of the arteriovenous communications of the sole of the foot was accomplished by injection of colored neoprene.

The distribution of the arteries of the foot varies individually. Physiologically, arteriovenous anastomoses derive blood directly from the arteries to the veins, thus diminishing the intracapillary passage. Dilatation exaggerates this function. With the increasing diameter of communications multiplied by a very large number of communications, a considerable quantity of blood may be derived, as in arteriovenous fistula. Reduction of peripheral resistance increases frontal pressure, the rate of circulation, and the reduction of lateral pressure. This explains why one may have a derivation of debit from one vascular territory to another, with very marked increase in vessels subject to parasitic sucking of the dilated arteriovenous communications. It is suggested that syndromes of blood derivation may exist in the parenteral vascular territories, i.e., issues of the same artery. The disease is probably purely functional in the beginning, with later pathologicoanatomical dilatation of the arteriovenous communications. This apparently hypothetical conception would seem to be supported by the cases reported, as demonstrated not only by the clinical facts but occasionally by the striking results of attempted operations.

The treatment of dilating the arteriovenous communications on the sole of the foot should be etiologic, and the true etiology can only be discovered by further anatomic and physiologic studies to explain the various syndromes and, above all, how the dilated arteriovenous communications can at times produce varices and at other times may only minimally affect the venous system but cause important changes in the arterial system. The Germans have suggested medical treatment but their results are not conclusive. Small doses of noradrenaline have been suggested. From the surgical standpoint, the indications are to interrupt the affluent arteries of the arteriovenous communications. Three routes have been suggested: (1) ligature of the affluents of the median and posterior parts of the heel; (2) ligature of the arterial affluents of the arteriovenous communications of the heel and lateral part of the sole of the foot, and (3) interruption of the arterial affluents of the arteriovenous communications of the sole and metatarsal area. Two cases of obliterating arteritis with dilated arteriovenous communications are described. Thirteen illustrations accompany the article. —*Edith Schanche Moore*

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Shock Hazard in Occult Iron Deficiency (Schockgefaehrdung durch larvierten Eisenmangel). W. Ott. *Helvet. chir. acta*, 1955, 22: 183.

Clinical analysis of unexplained fatalities, animal experiments, and good results obtained in exposing, preoperatively, patients who sustained hemorrhages to iron and increased protein orally, or plasma and iron intravenously, led the author to postulate the following:

Recurrent small hemorrhages lead to an occult iron deficiency without necessarily producing a frank secondary anemia. This causes a decrease in, and an inactivation of, important iron-containing ferments (cytochromes, catalases, peroxydases). Thus the oxygen transport in tissues is rendered more difficult and in turn aggravates the anoxemia produced by shock. Susceptibility to shock is particularly apt to occur in patients with iron deficiency when the usual compensatory increase of β_1 globulins fails to take place. Decreased β_1 globulin values accompanied by low iron combining power occurring prior to surgical intervention are ominous signs and require active therapy. Conversely, high values of β_1 globulin and latent iron combining power indicate a good prognosis.

In providing sufficient quantities of oxygen during anesthesia, modern practice shifted towards the first several postoperative days the untoward incidents that formerly occurred in iron deficient patients during surgery. Preoperative iron therapy also allows the peroxydases to detoxify the products of protein metabolism more efficiently, thereby causing a lower postoperative rise in temperature.

—*Sidney Smedresman, M.D.*

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Experimental Study of Renal Circulation in Burns (Estudio experimental de la circulacion renal en quemaduras). J. M. Beltran de Heredia. *Cirugia*, Madrid, 1955, 2: 20.

In the present study, the author attempts to correlate the effects of various degrees of burns on renal circulation with and without interruption of nerve stimuli to the kidney, as well as the effectiveness of ACTH in therapeutic doses. The method employed was a modification of Trueta's technique, the laboratory animal being the rabbit. The results were classified into four groups.

It was seen that when an extensive third degree burn was made on the back of a rabbit, renal ischemia occurred, which was confirmed by circulatory measurements taken immediately and after 6, 24, and 48, hours, and 4, 6, and 8 days. Corticorenal ischemia appeared immediately and lasted for 4 to 6 days. The ischemia is unilateral at first but soon becomes bilateral; however, it is usually only partial. It was found that third degree burns of 2 cm. width do not produce renal ischemia, nor do first and second degree burns. The principal mechanism involved in the production of the ischemia is of neurogenic origin; however, other humoral factors which could not be ruled out probably accounted for some part of the results observed. The response to ACTH confirmed this conclusion.

—*Stephen A. Zieman, M.D.*

ANESTHESIA

Accidents of Local Regional Anesthesia and Their Treatment (Les accidents de l'anesthésie loco-régionale et leurs traitements). Michel Portmann. *Anesthésie*, Par., 1955, 12: 682.

The fatal accidents occurring in man and experimental animals in local-regional anesthesia have a similar symptomatology and frequently develop during the first minutes of the operation, and occasionally during transportation of the patient from the anesthetic room to the operating room. Late accidents occurring some time after the operation are rare. There may be no warning symptoms. When present, they include a sense of thoracic constriction, malaise, respiratory difficulty, distress, sudden blanching of the skin and mucosae, with sweats, mydriasis, violent headache, a rapid thready pulse, and finally somnolence in a previously agitated patient, or euphoria in a previously distressed patient. These signs are warnings to redouble attention even when the pulse is still normal.

The clinical syndrome includes nervous, respiratory, cardiovascular, and neurovegetative symptoms. Nervous symptoms include coma, somnolence, or pseudoinebriation. As a rule, the patient remains conscious until the onset of more advanced stages of intoxication. Sensory symptoms include headache and frequently hypesthesia. Motor disturbances usually are dominant. Convulsions, usually generalized, and occasionally jacksonian epilepsy are characteristic of the crisis. Respiratory symptoms include acceleration and diminished excursions, later becoming slower and irregular, with dyspnea in some cases and respiratory syncope and cyanosis in others. Patients with cardiovascular disorders, neurovegetative disturbances, unstable and anxious patients are most subject to the effects of adrenalin.

The differential diagnosis includes coma, labyrinthine vertigo, the operation itself, hemorrhagic shock, inhibiting reflex due to vagal irritation, or irritation of reflexogenic carotid regions in cervical operations. Unusual cases include an uncertain diagnosis due to rupture of an aortic ectasia, pneumogastric compression by a hematoma, and other conditions.

The accidents may be due to the anesthetic solution employed, the technique of administration, or to the condition of the individual patient.

Concentration of the solution is less important than the total dose, a 2 per cent procaine solution being four times as toxic as a 1 per cent solution and a one-

fifth cocaine solution four times as toxic as a one-tenth solution, keeping in mind that the concentration in Bonnain's fluid is 33 per cent. Animal experiments indicate that procaine is six times less toxic than cocaine. Classified as to increasing toxicity are procaine, stovaine, cocaine, tetracaine, and butylcaine.

Accidents are rare in transcutaneous or transmucosal infiltrations of 0.5 per cent procaine solutions. Most accidents occur following truncular injections, as the anesthetic is not eliminated but absorbed. Contact anesthesias are most dangerous, the dosage being less easily controlled, the concentrations stronger, and being often applied to the mucosae that have great reflexogenic or absorbent power. The nasal and laryngotracheobronchial mucosae absorb more easily than the digestive tract mucosae. Intravenous injections must be avoided. Many accidents are due to overrapid administration. Immediate mobilization of the patient may play the determining role in cases of overdosage or too rapid administration. Accidents are more common in young persons and in certain disease conditions such as diabetes, alcoholism, heart disease, insufficiency of the liver or kidneys, and hypertension—anesthesia of any kind being more dangerous in hypertensive patients. Individual sensitization may have developed because of the administration of the same anesthetic years earlier, or as the result of contact with a chemically related substance even though the anesthetic has never been used before.

The prophylaxis of anesthetic accidents of this nature includes determination of the susceptibility of the patient, the proper choice of anesthetic and solution, and meticulous technique. The risk of the anesthetic must be considered in relation to the importance of the operation. Local anesthesia is not recommended for children, and in adults the minimum preliminary examination includes pulse, auscultation, lungs, oculocardiac reflex, and past history. Alcoholics are best operated upon under a general anesthetic. The preparation of decompensated cardiorenal patients includes rest in bed, oxygenation, mild cardiotonics, and diuretics, but a light general anesthetic is preferable in these cases in which the usual dose of adrenalin is likewise poorly tolerated. Should allergic symptoms be discovered, skin tests are indicated and local anesthesia is either dispensed with, or tiny doses are injected to observe the effect for five minutes before proceeding. In these cases, anesthesia-analgesia is best. The preliminary administration of antihistaminics or barbiturates is helpful; proper preservation of fresh solutions in the dark, and heating up to 37 degrees before administration are imperative. Solutions should be colored, to avoid confusion, and proper concentrations and total dosage should be tabulated. The dosage of adrenalin, if used, should not exceed 1 minim of a 1-1000 solution for 2 cubic centimeters of procaine (0.5 per cent). If more than 50 cubic centimeters are used the concentration should be further reduced. Adrenalin should not be used in cardiopaths, in patients with severe neurovegetative dystonias, or in certain regions such as the thyroid.

The technique used in the administration of the anesthetic must be perfect, with all precautions to have the patient comfortable and calm. Anesthetization should be performed on the operating table and with the patient in the position in which the operation is to be performed, preferably the dorsal position, or, in otolaryngological cases, in the half sitting position. Slow, gentle application is advisable with preliminary aspiration, to make sure that a vessel has not been entered. Careful observation for possible prodromal symptoms of accident should be maintained from the onset, as well as following the operation.

For major operations, an assistant should take the pulse regularly and also record the arterial pressure, respiratory rhythm, and condition of the facies.

All operating rooms must be equipped with easily accessible apparatus and remedies for use in the event of anesthetic accidents, since the life of the patient may depend upon a matter of seconds. Analeptics, needles, syringes, apparatus for artificial respiration and oxygen therapy or carbogen therapy under pressure must be at hand. Upon the slightest prodromal symptom, operation should be stopped immediately, and the head placed low to combat anemia of the cerebral centers. If the pulse is thready, the intramuscular injection of analeptics, or the administration of nicethamide or cardiazol intravenously is imperative. For cardiac syncope, the intracardiac injection of a few drops of a solution of 1 to 1,000 adrenalin may help in rare instances. For respiratory syncope, artificial respiration with oxygen under pressure is indicated, or the administration of carbogen or the injection of lobeline. Artificial respiration should be continued until regular voluntary respiration is resumed. For convulsions, the immediate administration of a barbiturate, preferably intravenous pentobarbital, should be supplemented by oxygen therapy, after which the patient will sleep for one or two hours. Should convulsions resume upon awakening, intravenous glucose solution with the addition of pentothiobarbital, if indicated, is in order. Even when apparently saved, the patient should remain for several hours on the table before moving. In some instances in which there is failure to respond to these methods, artificial hibernation (of Laborit and Huguenard) may save the patient. The summary is followed by a discussion. —*Edith Schanche Moore*

Marseilles Conference on Experimental Intracardiac Surgery Under Hibernation and Hypothermia (Colloque de Marseille chirurgie intracardiaque expérimentale sous hibernation et hypothermie). *Anesthésie*, Par., 1955, 12: 773.

THE RESULTS of experimental studies on hibernation and induced hypothermia in relation to intracardiac surgery are reviewed in the hope of evolving a successful method of opening the cardiac cavities by prolonging the arrest of circulation to the heart, by clamping the venae cavae and azygos vein, and of providing adequate protection to the brain and other organs during the period of isolation of the heart.

In methods evolved to date, including extracorporeal circulation of the artificial heart and lung, many problems of oxygenation, hemolysis, and coagulation remain to be solved. Newer methods of hypothermia and artificial hibernation have offered only a partial solution.

At the time of the present conference, it was decided to include a study of (1) methods permitting surgery

on the exsanguinated heart, (2) the risks involved therein, and (3) the available methods for combating such risks, or reanimation in relation to intracardiac surgery.

Following a discussion of the physiologic effects of hypothermia, its dangers in cardiac surgery are listed, the most serious being ventricular fibrillation that may be combated by electrical shock and chemical defibrillation. For gas embolism, Sheridan and Lang suggested the venous pump (1953) and Crafoord and Sening, of Stockholm, suggested that instead of attempting to prevent ventricular fibrillation, it should rather be induced by a mild electric shock; it can then be arrested following completion of the operation by two further electric shocks. Clinical results were encouraging. Hypothermia is attained by chilling the body or by chilling the blood stream.

With Laborit and Huguenard's method of artificial hibernation, refrigeration constitutes only a secondary factor to be used following neurovegetative inhibition with phenargan-largactil-dolosal, hydergine-phenargan-dolosal, and other substances. Somatotropin has recently been used also to prevent ventricular fibrillation and chills. Bigelow, of Montreal, is studying the hibernation gland of hibernating animals in the hope of isolating an extract which will be effective in increasing the resistance to cold in non-hibernating animals.

The results obtained with hypothermia in difficult cardiac operations in various countries are reviewed and compared with those of artificial hibernation as well as with the results of both methods combined, and the possible future results by association of these methods with the artificial heart and lung are discussed. Artificial hibernation in man is never equivalent to natural hibernation, and in neither hypothermia nor artificial hibernation has any method been perfected for protecting the brain against irreversible anoxia due to arrest of the circulation for 20 minutes. The maximum of tolerance is unknown.

The opinions of the various members of the conference are recorded, as well as the results of experiments in cardiac surgery under hypothermia on a series of 134 dogs and 19 monkeys as compared with those of Laborit and Cahn. Only 5 dogs of the former series survived. Clamping of the azygos vein and vena cava had a favorable effect on ventricular fibrillation, but no pharmacodynamic method actually prevented it. The brain appeared to be protected. Next, physical hypothermia was attempted with intracoronary prostigmin (Swan). One feature that was noted in both hypothermia and artificial hibernation was a marked drop in eosinophiles, in some instances to zero. Limiting the time of interruption of the circulation to ten minutes considerably increases the risk of operation. Operation should be done while the cardiac rhythm is as slow as possible, and the ventricular walls should be incised in diastole and not in systole in order to prevent a summation of cardiac excitations that give rise to ventricular fibrillation during the first minutes of clamping. Traction on the lips of the ventricular incision must be avoided, since it may give rise to increased frequency or cardiac arrest. Massage is used to combat dilatation of the right ventricle. There appears to be little to choose between physical or pharmacologic hypothermia. The circulation cannot be interrupted for an equal period at equal degrees of hypothermia, but may be interrupted longer during artificial hibernation. It is considered imperative that frequent consultations be held for the evaluation of these techniques in their application to human subjects.

Devin discusses intracardiac surgery under hibernation, and presents a study of different methods of refrigeration, of right ventriculotomies under hibernation, and of the possibilities of opening the left heart. Attempts to use the Thomas artificial heart with glass tube refrigerators of various dimensions and sizes, and Delorme's method of shunting a refrigerating circuit between the arteries and veins of the animal, failed, since the necessary state of hypocoagulability presented danger of hemorrhage, and if less heparin was administered the tubules became clogged. Of 23 dogs in which right cardiotomies were performed under Laborit's method of artificial hibernation, 5 survived for a considerable time after operation and most failures were attributed to ventricular fibrillation, cardiac thrombosis, and cerebral anoxia. Nothing in the 5 surviving dogs indicated that they had suffered an interruption of circulation. Attempts to open the left heart were made in 9 dogs, the chief problems encountered being interruption of the circulation and gas embolism. The only similar attempts in human subjects were for interventricular communications.

The importance of temperature in intracardiac operations is stressed, ventricular fibrillation being threatened in man at temperatures between 26 and 24 degrees, and in dogs below 28 degrees. In artificial hibernation, ventricular fibrillation occurs with the chest closed except at very low temperatures; with the chest open, in spite of intracardiac excitations, ventricular fibrillation does not occur above 18 degrees. Occasionally fibrillation develops upon opening of the thorax or on incision of the pericardium, in spite of artificial respiration with pure oxygen. It is difficult to tell whether such fibrillation is due to the development of hypoxia or anoxia during the course of hypothermia. Patients having their temperatures reduced must be placed under oxygen as soon as possible or even be hyperventilated, especially under 33 degrees, contradictory as this might seem to the theory that oxygen consumption is reduced at lower temperatures.

The various types of ventricular fibrillation are described, including spontaneous fibrillation in an open thorax, fibrillations associated with the operation, and fibrillation due to too rapid removal of the clamps. Methods for avoiding ventricular fibrillation, including the somatotropic hormone and infiltration of xylocaine into the Keith and Flack node, are discussed. The latter is said to prevent fibrillation in 95 per cent of cases. Experiments on monkeys and other animals are discussed.

The biologic section of experimental work on induced hypothermia and cardiac surgery in dogs under internal and external refrigeration included studies on the cerebral circulation, surgical technique, and biologic changes in the blood. A constant increase in gamma globulins was interpreted by some as a sign of shock and, in particular, increase of the alpha globulins of about 100 per cent in cases with a fatal termina-

tion. A similar increase has been noted in myocardial infarct, and here probably signified a condition of myocardial ischemia.

In hypothermia induced by external refrigeration, right ventriculotomy yielded a survival rate of 50 per cent. Ventricular fibrillation occurred late because of myocardial anoxia, and appeared to be the principal cause of failure.

The present status of research on chlorpromazine is discussed, as well as the two theories concerning the action of largactil, namely, as a block of the autonomous nervous system (Laborit) and as a narcobiosis (Decourt). Ordinarily chlorpromazine is credited with a sympatholytic, ganglioplegic, and vagolytic effect. Neither of the two former could be demonstrated by Donnet. The vagolytic action appears definite, but of minor importance. Chlorpromazine, alone, in doses up to 10 mgm. kgm. appears incapable of effectively blocking the bulbar centers, diminishing their activity only as it reduces and modifies the response of effectors. Largactil has been credited with a receptoneuroplegic action. Largactil alone does not seem to act according to Laborit's conception, but rather according to the hypothesis of Decourt. Six colored plates, 5 figures, and 4 tables accompany the article. —*Edith Schanche Moore*

Chlorpromazine; a Laboratory and Clinical Investigation. M. Bourgeois-Gavardin, W. K. Nowill, G. Margolis, and C. R. Stephen. *Anesthesiology*, 1955, 16: 829.

Chlorpromazine was studied in the laboratory with dogs, rabbits, and cats, and clinically. It was found unpredictable in therapeutic doses both in the animal and in the human being. Its variation of action may be due to the degree of sympathetic tone which exists in the patient at the time of the administration. Chlorpromazine produces hypotension, its extent depending on the amount given. It will prevent or modify both the cardiac and peripheral actions of even the most potent sympathomimetic amines principally because of the peripheral arteriolar vasodilating action of the drug. Chlorpromazine protects against the cardiac arrythmias induced by the sympathomimetic amines. Oxygen consumption in dogs receiving chlorpromazine showed an over-all tendency to increase, but not significantly. The clinical impression was that in some cases chlorpromazine may potentiate the action of anesthetic drugs. The antiemetic action of chlorpromazine was confirmed in a few cases. The unpredictability of action of clinical doses of chlorpromazine was emphasized.

—*Mary Karp, M.D.*

Cerebral Purpura Following Efocaine Anesthesia (Purpura cerebri nach Efocainanaesthesie). O. Geel. *Helvet. chir. acta*, 1955, 22: 251.

To prevent pain following resection of a right apicoposterior segment of the upper lobe under general anesthesia, the second to eighth intercostal nerves were blocked with 1.5 cubic centimeters each of efocaine. The first signs of toxic damage to the central nervous system appeared within 30 hours. They led to paraplegia, then to complete paralysis and finally death, six days postoperatively, due to circulatory insufficiency and respiratory paralysis. Autopsy showed purpura in the cerebrum, spinal cord, pons, medulla, and cerebellum.

By contrast a fatal case, following intercostal efocaine anesthesia, reported by Angeerer, Hung, and Head, showed that thrombosis was the predominating lesion in their patient, although severe damage to the vascular endothelium was observed in both of these patients.

Also reported in the literature are instances in which atony of the bladder, perirectal necroses, unilateral anhidrosis, severe prolonged neuralgia, injection neuritis, and probably permanent motor paralysis of the lower extremity followed efocaine nerve block.

Although vascular damage could not be reproduced in animal experiments, anatomic and chronologic factors implicate efocaine in producing lethal changes under certain conditions.

—*Sidney Smedresman, M.D.*

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Complications of Translumbar Aortography; Their Explanation and Avoidance; Experiences with the New Contrast Preparation "Urografin" (Die Komplikationen der translumbalen Aortographie; ihre Erklaerung und Vermeidung; Erfahrungen mit dem neuen Kontrastmittel "Urografin"). E. A. SCHRADER. *Fortsch. Roentgenstrahl.*, 1955, 83: 476.

THE MOST SERIOUS COMPLICATION of aortography would seem to be injection of the contrast medium into one of the branches of the aorta, particularly into the inferior mesenteric artery instead of into the aorta itself. Such an accident might result in severe disorders of the colon and other structures supplied by this arterial branch. Serious complications have occurred following unintentional injection of the higher branches of the aorta, such as the superior mesenteric artery, with complicating gangrene and lesser disturbances of the small intestine and cecum, and of the renal arteries with resulting temporary anuria. The author emphasizes the fact that all of these complications have developed after the so-called subdiaphragmatic or high level injections—in the section of the aorta between the renal artery and the diaphragm.

The present article is concerned only with lesions located at the aortic bifurcation or distal to this point. The author believes that one avoids complications by never injecting urografin above the level of the third to fourth lumbar vertebrae and by directing the needle distally. One of the roentgenograms reproduced indicates that on one occasion the author injected the inferior mesenteric artery. In this instance the artery was dilated, and acted as a source of collateral circulation; no harm was done. There is another factor of safety in the two-needle method used by the author; only one of the needles entered the inferior mesenteric artery, the other entering the aorta.

Another roentgenogram shows that the author injected the wall of the aorta, and a third that some of the contrast medium had been injected extra-arterially. No untoward effects were noted. The author believes that the absence of symptoms as a result of these unintentional errors is due to the bland character of the urografin, and that such errors cannot be entirely avoided.

With regard to the possibility of bleeding or hematoma formation from the puncture wounds in the aorta, the author states that in his experience with thousands of lumbar punctures, he has never encountered any extensive hematoma formation nor the development of an aneurysm.

It is thought that the matter of dosage is not too significant; two injections of urografin of 60 cubic centimeters each were given, one immediately after the other, without evidence of harm. The mechanical increase of intra-arterial pressures in the upper levels, however, should be considered. Roentgenograms are always taken with the patient in the prone position, and all constricting pressure distal to the point of injections is avoided.

The author believes that urografin is bland enough in its effects to reduce to a minimum the development of the complications sometimes associated with the use of other preparations, and that its opacifying qualities are sufficiently effective to provide most of the desired information. —*John W. Brennan, M.D.*

The Value and Limitations of Radiology in Acute Abdominal Conditions. J. FRIMANN-DAHL. *Brit. J. Radiol.*, 1955, 28: 581.

THE AUTHOR discusses briefly the value of the roentgen examination in the diagnosis of acute abdominal conditions. He stresses the need for close co-operation between the surgeon and the radiologist. In most cases the radiologist is called upon only for the diagnosis but occasionally he is called upon for therapeutic reduction of an obstruction, as in some cases of volvulus, and in instances of intussusception in children.

The author states that erroneous diagnoses were made in only 5 per cent of 445 cases of obstruction of the small bowel. This percentage indicates a high degree of accuracy of the roentgen diagnostic procedure, and it is believed that the majority of diagnostic errors are confined to strangulating obstructions and to acute vascular accidents. The use of barium both by mouth and by enema as an aid in the differential diagnosis is stressed by the author.

—*Moris Horwitz, M.D.*

Studies with Reference to the Use of the New Bile Contrast Media in Healthy Patients and Those with Liver Disease (Untersuchungen ueber die Anwendung der neuen Gallekontrastmittel bei Gesunden and Leberkranken). F. LEUPOLD and F. HEUCK. *Fortsch. Roentgenstrahl.*, 1955, 83: 464.

FIFTEEN PATIENTS with apparently healthy livers were injected with the new contrast preparations; 10 of these were given the ordinary biligrafin and 5 were given biligrafin forte or SH 307. Since in these 15 patients no abnormalities were produced by the intravenous administration of the drug, attention was directed to those with liver involvement. There were 31 patients in whom according to the clinical symptoms and the results of the liver function tests liver damage was present. Sixteen of these were studied with especial care. The results are given in tabular form. In 9 liver tests were made both before and after the injection of biligrafin; in these no significant changes were induced. In 1 of these patients the Takata reaction became positive following the injection; in 2 the previously positive Takata reaction became negative.

The variations in the bilirubin content and in the phosphatase titer were not greater than those usually encountered in cases of liver damage. In the matter of clinical manifestations no effect from the injection could be determined; the nausea and vomiting, and the chills and fever reported by other authors were not encountered in these cases. A fall in blood pressure after the injection was occasionally observed, but except in one instance no harmful effect was noted.

This exception concerned a 57 year old woman without evidence of liver involvement. Before the injection of the biligrafin her blood pressure was 110/70 mm., Hg. The patient collapsed 2 minutes after the injection, the blood pressure falling for 3 minutes to 80/60 mm., Hg. Then the patient recovered, but on sitting up again collapsed and the blood pressure could not be determined. Under the influence of intravenous stimulating preparations the patient recovered after 5 hours. This episode occurred in a patient who had given no previous indication of intolerance to the drug. A week later the liver tests afforded no evidence of liver damage.

The authors assume that in patients who are not markedly adipose, a delay of more than 40 minutes in the appearance of the dye after the injection of 20 c.c. of biligrafin indicates a disturbance in the excretory function of the liver. In adipose patients the delay tends to be greater, but this may be due to inadequacy of dosage. In the aged there were frequently observed delays in dye excretion, but no correlation between age and delayed excretion of the drug could be determined. With the injection of large doses of biligrafin (40 to 60 c.c) excretion through the kidney was noted in 11 patients; this excretion the authors regard as a sort of safety valve effect. When both liver and kidney show a disturbed function (hepatorenal syndrome) the injection of biligrafin is regarded as contraindicated.

The excretion of biligrafin through the liver is not affected in cases in which the serum lability tests (Takata Ara, thymol test) give pathologic results. In patients with increased alkaline phosphatase and cholesteremia as a rule no excretion of the dye occurs.

To demonstrate opacification of the biliary radicals, the authors have been using a soft tube (65 to 75 kv.; 100 m.a.), but opacification of the hepatic parenchyma itself is not easily recognized. The vascular pattern of the lung tissues which are superimposed on the cupula of the liver may add to the difficulty of interpretation. With increased dosages this pattern cannot be recognized, or only recognized with difficulty within the liver shadow.

—*John W. Brennan, M.D.*

Intravenous and Oral Cholecystography; Comparison of Results in 150 Cholecytographies with Biligrafin with Those in 150 Cholecystographies with Iodobil (Intravenoese und orale Cholezystographie; Vergleich von 150 Biligrafin mit 150 Jodobil Cholezystographien). O. HUBACHER. *Fortsch. Roentgenstrahl.*, 1955, 83: 471.

ON THE AUTHOR'S SERVICE at Thun, Switzerland, the results of 150 cholecystographies on ambulant patients with intravenous injections of biligrafin and biligrafin forte are compared with those obtained in a previous group of 150 ambulant patients observed at the same institution, to whom iodobil was given orally.

In carrying out the biligrafin cholecystographies the injection is made without any special preparation of the patient except that the subject be fasting. The exposure is made with the patient prone and placed so that superposition can be avoided. In the rare instances in which such superposition cannot be avoided, tomography may be used with benefit. The exposures for the bile passages are made at intervals of 5, 10, 15, and 30 minutes after the injection. The first exposure for the gall bladder is taken after 60 minutes, and perhaps a second exposure after 75 minutes. Further exposures have been needed only in exceptional instances.

The author stresses the significance of evacuation of the gallbladder; this is demonstrated by an evacuation exposure, 40 to 60 minutes after administration of two egg yolks. When biligrafin forte is used the author believes that reliable results can be obtained in practically every case.

Comparative tables show the results obtained in these two groups of patients. For the demonstration of gallstones in the gallbladder the intravenous method is about twice as effective as the oral, and the advantage in the demonstration of stones in the bile passages is still greater. With the oral method, as a rule, the bile passages are not visualized at all.

What the surgeon wishes to know from the roentgenologist is whether a stone is present and if so, where is its location. The roentgenologist with the special technique described can furnish this information in almost every instance.

From his experiences with the oral and intravenous methods the author concludes that the peroral preparation should be limited to exceptional instances. The principal indication for its use is the desire to determine the "concentrational capacity" of the gallbladder; even here the author is not sure that the intravenous method will not furnish a satisfactory answer to the question.

In the matter of the determination of the presence of stone, the author cites the results in a group of 12 intravenous cholecystographies in patients who had previously been examined with iodobil and later with biligrafin. In all these instances the complaint was typical colicky pain in the right hypochondrium. With iodobil the diagnosis of cholelithiasis was made in only one patient of this group. Among the remaining 11 patients visualization was unsuccessful in 7 and positive in 4, without, however, the demonstration of stone.

With the intravenous method a gallstone was demonstrated in 10 instances, and in an additional patient the presence of stone was excluded. With the oral method the diagnosis of stone would have been impossible or incorrect in 10 of 12 cases.

The author concludes that the intravenous method, though more difficult and costly, is worth the cost in the earlier and more reliable diagnosis of the cause of the patient's trouble. —*John W. Brennan, M.D.*

The Roentgenologic Manifestations of Synovial Sarcoma. RICHARD M. CRAIG, DAVID G. PUGH, and EDWARD H. SOULE. *Radiology*, 1955, 65: 837.

SYNOVIAL SARCOMAS are unique and relatively rare malignant neoplasms frequently arising near, but not necessarily from, the synovium of joint capsules, bursae, or tendon sheaths. The authors present the clinical and roentgenologic findings in 24 cases of synovial sarcoma encountered at the Mayo Clinic during a 10-year period.

These tumors are found most often in young adults and tend to run a progressive course. They most fre-

quently involve soft tissues in the region of the knee, foot, thigh, ankle, hand, and elbow.

Their roentgenologic diagnosis is suggested by the presence of: (1) a homogeneous soft-tissue mass near a joint—this mass usually has sharp borders and occasionally is lobulated; (2) irregular calcification within the tumor (in more than one-third of the cases); and (3) secondary invasion of contiguous bone (in approximately one-third of the cases).

MISCELLANEOUS

Diagnostic Radiography with Radioactive Isotopes. JOHN B. STORER and ADOLPH T. KREBS. *U. S. Armed Forces M. J.*, 1955, 6: 1740.

OVER THE PAST 2 YEARS the Army Medical Research Laboratory has devoted considerable effort to the development of a practical completely mobile diagnostic x-ray unit. A workable model which weighs less than 50 pounds and which will operate under field conditions without specialized equipment has now been developed. Because the radiation is emitted by a radioactive isotopic source, no electrical generators, wiring circuits, or control panels are required. The radiographic films may be developed in a "self-contained" cassette or film holder, and no solutions, water, or darkroom are required. A 400 mgm. (about 1/70th of an ounce) sample of thulium obtained from the Ames Laboratory was activated in the materials-testing reactor at the National Reactor Testing Station in Idaho. This active material was doubly encapsulated in a thin aluminum container to prevent any leakage of radioactive material and placed in a lead hemisphere 5 inches in diameter to prevent the exposure of transporting personnel to radiation. The sphere contained appropriate ports for loading and for exit of the radiation beam. A shutter mechanism was incorporated to allow precision of exposure times. The entire unit, which weighed 48 pounds, was then mounted on a pack frame for easy mobility. The source unit is extremely simple to operate. It is set up for use on telescoping tripod legs which allow for the adjustment of distance. Exposure times are measured with a stop watch or with a sweep second hand of a wrist watch. Roentgenograms taken with the portable source may be exposed in a completely "self-contained" cassette which does not require dark room facilities. Thulium gamma ray source is not necessarily the only or best method of isotopic radiography.

After considering alternative methods of isotopic radiography it was decided to attempt to use pure beta-emitting sources to solve the problem by using the basic principle by which conventional x-rays are produced. A commercially available beta particle source consisting of radioactive strontium and radioactive yttrium in an equilibrium mixture was obtained. The active material as obtained was completely encased in a steel cylinder. At one end of the cylinder the wall is very thin (0.002 inch of steel and 0.010 inch of aluminum). This wall is sufficiently thin to allow some of the beta particles to pass through it. Such beams of beta particles are widely used in medical practice. The emergent beam consists almost entirely of beta particles emitted from the yttrium which gives off the more energetic particles. Practically none of the beta particles emitted by the strontium are able to penetrate this window. A certain percentage of the beta particles stopped by this source material itself, the walls of the cylinder, or the thin window gives rise to x-rays (characteristic and/or "Bremsstrahlung"). The entire source was placed in a lucite well which absorbed the beta particles without interfering particularly with the x-ray beam. Despite a number of technical disadvantages, remarkably good roentgenographs have been obtained with the strontium source. Diagnostic roentgenography of human beings by means of radioisotopes is still largely in the experimental stage, although feasibility of the use of thulium has been amply demonstrated and roentgenographic units employing this material will probably become available in the near future. Such portable units would undoubtedly prove of great value to the medical services for use in the field (battalion aid, collecting, or clearing stations) in remote or isolated installations or for emergency use in the event of civilian disasters.

Frank L. Hussey, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Recent Developments in the Field of Protein Metabolism (Acquisitions récentes dans le domaine du métabolisme des proteines). G. BICKEL. *Helvet. chir. acta*, 1955, 22: 368.

IN THIS TREATISE the author presents a brief historical review of the concepts of protein metabolism since the end of the eighteenth century, and discusses recent developments with regard to their importance to the surgeon. Only a few high lights can be given here of the wealth of information contained in this interesting article.

During the last 20 years, theories on the subject have changed radically. To give but one example: prior to that time, physiologists distinguished between two groups of proteins—the tissue proteins which were assumed to be markedly stable and immovable, and the alimentary proteins which are broken down to amino acids and were assumed to be used almost exclusively for the production of energy and the replacement of the plasma proteins. This concept led to the assumption of a double nitrogen metabolism: (1) the endogenous, without relation to protein ingestion, limited to the replacement of used-up tissue proteins and terminating in the excretion of creatinin and neutral sulfur; (2) the exogenous, dependent on ingestion, serving only the energy needs, and eliminated in the form of urea and inorganic sulfates.

As a result of the experimental work of Whipple and Schoenheimer, this dualistic concept has been definitely abandoned. It is now known that the tissue and the plasma proteins are in constant interrelation, and that the endogenous nitrogen metabolism cannot be separated from the exogenous. With the help of radioactive tagged protein isotopes, Schoenheimer and his collaborators have demonstrated that a constant and active interchange takes place between blood and tissue proteins.

Another radical change of opinion concerns the amount of protein in the food. In the beginning of this century, it was believed that 40 to 50 grams were optimal for the adult, and that high amounts of protein had deleterious effects on the kidneys and arteries. This concept has been refuted by the experiences of Arctic explorers who lived for years on a diet of meat and vitamins only, and also by experimental work. It is now assumed that for the adult, 1 gram per kilogram of body weight is adequate whereas the growing child and the pregnant woman need 2 to 4 grams per kilogram. In certain pathologic conditions the protein consumption should even be considerably higher. These conditions include hyperthyroidism, acute febrile illnesses, and stress. During infectious diseases, a high protein diet is necessary not only for replacement of the destroyed tissue proteins but for increased production of immune antibodies. Also in sprue and ulcerative colitis, increased protein supply is necessary because of the deficiency of intestinal absorption. The same is true for chronic nephritis because of the loss of protein in the urine, and for liver diseases, especially cirrhosis and infectious hepatitis, to counteract fatty degeneration. This is particularly important in the preoperative period. The daily protein requirements for these patients should be 120 to 135 grams.

The storage of the absorbed amino acids and the synthesis of tissue protein are discussed. Immediately after absorption the largest portion of the amino acids are stored temporarily in the liver, the remainder in the muscles and other organs. The amino acid level in the liver and other tissues is at all times higher than that of the blood. The greatest portion of the amino acids is used for replacement of cell protein which goes on without interruption, even in the fasting individual. Using tagged amino acids in experiments with rats, one worker observed that 10 per cent of the liver protein and 2.5 per cent of muscle protein are replaced within three days. The total plasma albumin, the fibrinogen, and a small fraction of the globulins are synthesized in the liver. The origin of the globulins is still an open question; it is assumed that for the greatest part they are produced by the reticuloendothelial system, the lymphocytes, and the plasmocytes. This assumption is supported by the observation that in liver disease the albumin blood level drops and the albumin-globulin ratio is reversed. After severe hemorrhage the lost plasma proteins are replaced within one to two weeks in the dog, and in ten days in man. This holds true even for the fasting organism and proves that tissue and plasma proteins are interchangeable.

The different plasma proteins and especially the determination of the immune globulins, the agglutinins, and the enzymes are discussed and the methods of their differentiation are described. These include determination of solubility, ultracentrifugation, and electrophoresis. Electrophoresis is technically the simplest of these methods but has the disadvantage of being the least exact. Proteins of quite different chemical structure may have identical or quite similar velocities in the electrical field and have to be differentiated by other methods. Paper microelectrophoresis, with one drop of plasma, permits differentiation of the fractions of protein. If the total plasma protein is known, it is easy to calculate the proportion of the different fractions. A further advantage is that the polysaccharides and the lipids can be identified by use of the same method.

Other subjects discussed in this treatise are the functions of the different plasma proteins, blood coagulation, the synthesis of hemoglobin, hypoproteinemia and hyperproteinemia, afibrinogenemia, agammaglobulinemia, and other pathological conditions. In multiple myeloma and in certain atypical leucemias, paraproteinemia is found; that is, the appearance of abnormal protein fractions which are not present in normal plasma.

—Werner M. Solmitz, M.D.

Protein Problems in Surgery (Eiweissprobleme in der Chirurgie). H. HEUSSER. *Helvet. chir. acta*, 1955, 22: 394.

THE AUTHOR discusses the importance to the surgeon of disturbances of protein balance, their symptomatology, diagnosis, prophylaxis, and treatment.

Protein deficiency may be due to a multitude of factors. Muscular inactivity in prolonged bed rest, or immobilization by plaster casts leads to considerable protein loss which cannot be prevented by a high protein diet. Besides the loss of protein as a result of acute and chronic hemorrhages, plasmorrhagia, as it occurs in extensive burns, is responsible for the loss of enormous amounts of protein. The same is true of acute intestinal obstruction in which the intestinal walls are saturated with serum, and in peritonitis in which the exudate contains large amounts of protein; protein deficiency is an important factor in the causes of death of patients with these conditions. Extensive inflammations, crush injuries, emesis, diarrhea, and purulent wounds with long continued drainage are other important causes of protein loss.

Insufficient nutrition and insufficient absorption of protein as it occurs in colitis and similar conditions, disturbances of protein synthesis in hepatoses, nephritis, and thyreotoxicosis are other important factors. In severe illnesses and also after operations and following injuries, a negative nitrogen balance, which cannot be prevented by a high protein diet, is present for a long period. The nature of this protein loss is not known; it has been termed "toxic protein catabolism." The amount of protein loss caused by surgery varies with the type of intervention; the loss is usually between 40 and 150 grams daily for the first few postoperative days.

In discussing the symptomatology, the author emphasizes that the protein losses in patients with intestinal obstruction and peritonitis are often deleterious and may be overlooked because, with simultaneous dehydration, the blood protein level may be nearly normal. Immediate replacement by large transfusions of plasma is indicated, the more so because obstruction or peritonitis is not only the cause of the protein loss but the protein deficiency may be responsible also for the absence of peristalsis.

In addition to the general symptoms of asthenia, anorexia, and hypotonia, the effects of protein loss on the individual organs are discussed. These included the delayed healing of wounds and fractures, poor peristalsis, oliguria, disturbances of liver function, lowered resistance against infections, hypoproteinic edemas, and weight loss.

An exact diagnosis of protein deficiency is often difficult for several reasons: (1) in dehydration, the plasma protein level may be normal or even increased as a result of the loss of water; (2) even in a marked drop of plasma albumin the total protein may be nearly normal if the globulin is increased. Therefore, the albumin/globulin ratio should always be determined; and (3) even a correctly evaluated plasma protein level does not always permit of conclusions as to the total body protein because in chronic protein deficiency the plasma proteins stay on a normal level much longer than the tissue proteins. Determination of the plasma albumin is of special importance because there is a greater decrease of albumin in protein deficiency than of the other protein factors. Albumin deficiency is probably the principal cause of hypoproteinemic edema.

Other important diagnostic tests are determination of the colloid osmotic pressure and of the nitrogen balance. Localio and his associates have made an interesting suggestion, i.e., to determine directly the tissue protein content. In chronic protein deficiency the fasciae are involved first, then the muscles, and only some time later the plasma proteins drop. They excise small pieces of fascia and muscle and determine their nitrogen content. The author of this article could confirm these findings by experiments of his own.

The prophylaxis of protein deficiency includes a preoperative and postoperative high protein diet, infusions of blood, plasma, or amino acids to prevent delayed healing of the wound, insufficiency of sutures, decubitus, paralytic ileus, and other complications. In patients with protein deficiency, postoperative infusions of water and electrolytes should be used with great caution because dilution of plasma beyond the critical point may lead to lung edema and edema of the operative wound. In such cases infusion of plasma or plasma expanders is preferable.

In difficulties of deglutition or extreme anorexia, feeding by stomach tube, or after gastrostomy or jejunostomy, is often successful. It is possible to supply 500 grams of protein and 6,000 calories daily by tube.

The transfusion of whole blood is of great benefit in the treatment of postoperative anemia but is of little value for the replacement of protein, as 1,000 cubic centimeters of blood contain only 35 grams of plasma protein. The same applies also to normal plasma, whereas concentrated plasma offers a better chance for replacement of protein loss. The injection of albumin increases the blood volume and the protein level and normalizes the colloid osmotic pressure. It is especially indicated in shock and in the acute hypoproteinemic syndrome. Intravenous or oral administration of amino acids is of great value and is discussed in detail. The author uses a mixture of 33 grams of amino acids, 50 grams of glucose, 50 grams of ethyl alcohol, and 3 grams of sodium chloride in 1,000 cubic centimeters of blood. This preparation contains all ten essential amino acids and has a caloric value of 662.

—*Werner M. Solmitz, M.D.*

A Re-Examination of Certain Aspects of the Histogenesis of the Healing of Cutaneous Wounds; a Preliminary Report. THEODORE GILLMAN, JACK PENN, DORIS BRONKS, MARIE ROUX, and Others. *Brit. J. Surg.*, 1955, 43: 141.

THE AUTHORS present a rather impressive study in both animals and humans, the results of which are in direct disagreement with some of the current concepts of wound healing. Previous impressions about the healing of incised and excised wounds are compared with their newer findings, and the article is worth reading as a review of wound healing.

In both types of wounds the epithelium was the first tissue to regenerate. Inversion of the epithelium at the edges of incised wounds, followed by invasion of the epithelium into the wound as well as along the suture puncture wounds, suggest that perhaps we need to modify our present methods of wound closure. In

excised wounds, such as a split-skin donor site, the epithelium grew beneath the clot or transudate over the wound within a period of 48 hours. This was followed by the development of edematous new connective tissue beneath the epithelium, which was not dense enough to hold tight the epithelium for 10 to 12 days, and suggests that removal of the dressings earlier might lead to the dislodging of the new epithelium. Epitheliohyperplasia then leads to many prominent "pseudo rete-pegs" present up to 20 days. These gradually become pinched off and much less prominent between the twentieth and the fortieth days, suggesting that about the sixteenth day is optimum for taking a "second crop" split-skin graft. The early growth of epithelium in both incised and excised wounds seems to be important in evoking and later modifying connective tissue and new vascular responses during healing.

It is finally suggested that more study of wound healing might be helpful toward the understanding of carcinogenesis. —*Roger D. Williams, M.D.*

Establishing a Skin Bank; Use and Various Methods of Preservation of Postmortem Homografts. JAMES BARRETT BROWN, MINOT P. FRYER, and THOMAS J. ZAYDON. *Plastic & Reconstr. Surg.*, 1955, 16: 337.

POSTMORTEM HOMOGRAFTS are secured in the same manner and used for the same conditions as live donor fresh homografts. Large amounts of skin can be obtained postmortem and stored for emergency use.

The technique of establishing a hospital skin bank is described. Postmortem skin grafts are obtained in the operating room or autopsy room under sterile conditions. The skin may be stored for use up to 21 days in an ordinary refrigerator at 3 to 5 degrees C. The storage time may be increased several months if the grafts are immersed in nutrient media. Storage for long periods of time in glycerol at low temperatures (—79 degrees C.) is effective. Skin grafts may also be lyophilized and stored indefinitely at room temperatures. Skin that has been processed by the freeze-drying technique is more practical for prolonged storage and transportation and appears to be retained as long as a viable preserved skin homograft by the recipient.

Homografts are life-saving in affording temporary biologic coverage in patients with extensive skin loss. The homografts "take" on raw surfaces not unlike autografts and persist as coverage for 10 to 30 days. Permanent healing is secured with the patient's own skin as soon as he can tolerate the transference. The use of postmortem homografts should be accepted as a standard surgical procedure. There is little reason to use homografts from live donors other than for transference between identical twins.

Harvey W. Baker, M.D.

The First Lumbar Root Syndrome. O. W. LEITCH. *Med. J. Australia*, 1955, 42: 842.

THE FIRST lumbar root syndrome is a common painful condition which is frequently mistaken for many of the common painful lower abdominal conditions and occurs over part or whole of the first lumbar segment, unilaterally or bilaterally, with definite areas of well localized tenderness of skeletal origin. It is one of the commonest of all segmental pains; segmental pain occurs most frequently in relation to those vertebrae in which the greatest strain occurs. The vertebral bodies and disc spaces in the upright position are primarily concerned with weight-bearing. The apophysial joints carry out the function of check ligaments and are subjected to the strain taken by the vertebrae in carrying out this function. When the body is flexed, the apophysial joints become weight-bearing in addition to their normal check function. These joints represent a seesaw, with the body and disc as the fulcrum, so that movement of one will be mirror-imaged by the other, and as a corollary strain of one in certain positions may strain the other. The posterior spinal nerve root as it lies on the capsule of the apophysial joint is likely to be affected by traumatic inflammatory changes involving these joints resultant on injury, whether a single trauma, repeated minor trauma, or the result of persistent strain. The sites of maximum pain and tenderness are at the edge of the erector spinae muscle opposite the center of the twelfth rib, and in front in the iliac fossa near the edge of the rectus abdominis, close to McBurney's point, or more medially in the case of the iliohypogastric, and in the lower part of the iliac fossa in the case of the ilioinguinal nerve.

Pains of segmental distribution may arise from irritation of the nerve root itself, which, in the case of the first lumbar segment, may result from first or second lumbar disc prolapse or from involvement of the posterior root in the adjacent disease arising in the apophysial joint. Pain may also arise from irritation of the segmental fibers in a nerve or its branches secondary to a condition irritating the nerve along its course. Thirdly, the pain may be referred from a structure supplied by the roots.

The most probable etiologic factor appears to be difficulty within the apophysial joint itself, either root irritation subsequent to traumatic arthritis, or as a referred pain over its corresponding segmental supply. Another factor would be muscle spasm or scoliosis. The pain may be over the entire segment with loin pain and backache corresponding to the posterior primary ramus; there may be lower abdominal pain up to the level of the umbilicus and sometimes over the iliac crest to the upper lateral aspect of the thigh (iliohypogastric element); and there may be pain extending down to the testis and inner aspect of the thigh (ilioinguinal element). The latter is true in a small percentage of cases and frequently the complaint of pain or tenderness was only a part of the whole syndrome. The onset may be spontaneous, but often follows an injury received in the flexed position. The traumatic type of pain generally occurs in the 35 to 40 year age group.

The pain pattern may be mechanical, inflammatory, or a combination of the two. In the author's series of cases, the mechanical was the most common sequence with the pain aggravated by general or particular movements or positions. In the acute stage almost any movement is painful and there is muscle spasm with scoliosis concave to the side of the lesion. In the mechanical sequence the pain is relieved by morning, becoming worse with movement during the day. In the inflammatory sequence the pain is severe

at night, with morning stiffness which decreases with daily movement. In the inflammatory lesions, a throbbing element is added to the pain. The combined sequence is usually seen in the arthritic patient.

Relative to differential diagnosis, this type of root pain may be confused with renal colic, pyelitis, appendicitis, diverticulitis, inguinal hernia, gynecological disorders, and hip joint pain. Essential in making the diagnosis is a painstaking history, and recognition of the condition as a syndrome. Careful elucidation of the pain type and sequence generally separates the syndrome from visceral pains, as does the absence of associated visceral symptoms.

One of the methods of treatment has been external fixation in the form of a spinal brace to immobilize the joint. Operative treatment has consisted of disc exploration and subsequent fusion of one type or another. As a conservative measure, lumbar root block is most effective and not only provides temporary relief but can become a permanent cure probably by releasing the muscle spasm. The first lumbar transverse process is located two fingers-breadth away from the spinous process, and after the needle is advanced to the transverse process it is angled to pass below it a further one-half to three-quarters of an inch where the nerve is situated. In the region of the nerve root, the needle itself or the pressure of the anesthetic agent may reproduce the pain. This phenomenon not only helps to confirm the diagnosis but assures one that relief can be expected by the block.

—*James H. Holman, M.D.*

Roentgen Therapy of Vertebral Angioma (Zur Röntgentherapie des Wirbelangioms). GEORG FUCHS. *Arch. Geschwulstforsch.*, 1955, 9: 1.

IN ORDER OF FREQUENCY of benign tumors of the spine, angioma seems to occupy first place. Women are affected more frequently than men, and the lesion usually occurs in advanced age. Although as a rule only one vertebra is involved, pathologic changes may occasionally be demonstrated roentgenologically in two or more vertebrae. In the overwhelming majority of cases the lesion remains asymptomatic and is accidentally discovered in the course of roentgenologic studies or at postmortem examination. The usual location of angiomas is the lumbar spine or the lower portion of the dorsal spine.

In the roentgen film the involved bone appears blown up, its image being occupied by an irregular network with wide meshes. Characteristic vertical, parallel osseous lamellae, seen in pictures taken in lateral direction, apparently prevent a collapse of the involved bone. Angiomas originate in the vertebral bodies but may occasionally spread to the arches, discs, or ribs. Clinical symptoms, if any, are attributable to compression of the spinal cord or the nerve roots.

Until recently operation was the method of choice, but reports of successful roentgenologic treatment of angiomas have been appearing in the literature with increasing frequency.

The author reports 5 cases of angioma treated in this manner, with excellent results in 3 of the patients. The unequivocal result in one patient was due possibly to the presence of osteoporosis and spondylarthrosis; no follow-up examination could be obtained in the fifth patient.

In order to avoid untoward effects on the spinal cord, the author recommends relatively small doses and narrow portals of entry, viz., 170 kilovolts, 0.5 mm. copper filter, and a distance of 40 cm. From 12 to 15 treatments, with a total dose of from 2,400 to 3,000 roentgens, are usually employed.

—*Joseph K. Narat, M.D.*

Tumors and Leucoses in Mice Induced by Flax Fibers and Cigarette Paper (Durch Flachsfasern und Zigarettenpapier ausgeloeste Geschwuelste und Leukosen der Maus). JURAJ KÖRBLER, PAVAO FRANK, and VIKTOR TURNER. *Arch. Geschwulstforsch.*, 1955, 8: 305.

IN A PERUSAL of two statistical reports, the authors observed that the incidence of carcinoma of the lower lip in women of Croatia, Yugoslavia was more than ten times higher than its incidence in American women. They suspected that this unusually frequent occurrence of carcinoma of the lower lip may be caused by the technique used in spinning by Croatian women who draw the spinning thread between the lips to moisten it by saliva.

To study the carcinogenic properties of flax fibers, 1 cubic centimeter of various extracts of flax fibers were injected subcutaneously in mice. Alcoholic flax extract dissolved partly in Ringer's solution and partly in human saliva was injected in 60 animals, and suspensions of fibers ground in a mortar and suspended in saline or saliva in another group of 65 animals. In 3 of the 125 animals a carcinoma developed and in 6, a lymphatic leucemia. The incubation period varied between 5 and 15 months.

As cigarette paper contains a large amount of flax fibers, similar experiments were done in another series of 80 mice. An aqueous distillate of cigarette paper was painted on the skin daily, for 5 months. Of 13 animals so treated, leucemia developed in 5. In another group of 10 animals, cigarette paper was implanted under the skin. In 1 animal of this group carcinoma developed and in 2, leucemia. In still another group of 46 mice, a suspension of ground cigarette paper in Ringer's solution or in saliva was injected subcutaneously; in one of these animals leucemia developed.

Altogether, 205 mice were subjected to the implantation of flax fibers or cigarette paper subcutaneously or cutaneously. Of these, carcinoma developed in 4 and lymphatic leucemia in 14 mice. The tumors could be transmitted to other animals by implantation, which proved that these were true malignancies.

—*Werner M. Solmitz, M.D.*

Transmittable Leucosis in Mice Produced by the Implantation of Flax Fibers (Eine durch Implantation von Flachsfasern erzeugte uebertragbare Leukose der Maus). JURAJ KÖRBLER, PAVAO FRANK, and VIKTOR TURNER. *Arch. Geschwulstforsch.*, 1955, 8: 320.

THE AUTHORS produced leucemia in mice by the implantation of crushed flax fibers in suspension. These leucemias could be transmitted to other animals by the subcutaneous, intravenous, or intraperitoneal injection of blood or liver, splenic tissue, or lymph node tissue of the leucemic animal. The incubation period,

from the time of the injection to the onset of the leucemia varied between 1 month and 6 months. At autopsy, the findings in the animals in which leucemia had been transmitted were the same as in those with the original leucemia, i.e., great enlargement of liver, spleen, and lymph nodes. The histologic picture of the bone marrow, the liver, the spleen, and lymph nodes was that of a myeloid leucemia.

In a number of animals a sarcoma developed at the site of the injection. By transmission of the sarcomatous tissue, the authors succeeded in producing leucemia and/or sarcoma in other animals. This observation (also made by other investigators) sheds an interesting light on the connection between leucemia and other malignant tumors. The leucemias and sarcomas can be transmitted from one animal to another in up to 11 passages.

Altogether, 215 animals were subjected to the transmission of blood, or of sarcomatous or leucemic tissues by various methods. In 29 of these, sarcoma only developed, in 24 leucemia only, whereas in 50 animals sarcoma as well as leucemia was found. In 112 animals the transmission did not cause a pathologic condition. —*Werner M. Solmitz, M.D.*

Kurloff's Bodies in the Leucosis of a Mouse Subjected to Implantation of Flax Fibers (Kurloffsche Koerperchen bei der Leukose einer durch Implantation von Flachsfasern vorbehandelten Maus). JURAJ KÖRBLER, PAVAO FRANK, and VIKTOR-TURNER. *Arch. Geschwulstforsch.*, 1955, 8: 315.

THE AUTHORS produced malignant tumors and lymphatic leucemia in mice by subcutaneous injections of flax fiber suspensions. They present a detailed macroscopic and microscopic report of the autopsy findings in one of these mice and discuss the blood picture observed two days before death. Autopsy showed marked enlargement of all lymph nodes, especially in the mediastinum, and of the liver and spleen. The spleen occupied almost the entire left half of the abdominal cavity and the liver was three to four times the normal size. Microscopic examination revealed the picture of a reticuloendotheliosis. The differential blood count was within the normal limits.

The most interesting finding was the presence of Kurloff's bodies in the protoplasm of large monocytes.

The literature on Kurloff's bodies is reviewed briefly. There appears to be no agreement as to whether they are endocellular parasites (rickettsia) or an indication of degeneration of the lymphoid tissue. Their occurrence in mice has not been reported previously.

—*Werner M. Solmitz, M.D.*

The Effect of Celandine Alkaloids on the Growth of Ascites Tumors in Mice (Die Wirkung der Schoellkrautalkaloide auf das Wachstum des Maeuseaszitestumors). HELMUT WIDMANN. *Arch. Geschwulstforsch.*, 1955, 9: 6.

EXTRACT OF CELANDINE, which belongs to the poppy family and has the latin name chelidonium major, is given in Latvia in the form of tea to patients with malignant tumors. Lettré was able to show that celandine alkaloids exert an inhibiting effect on mitoses in cultures of cardiac fibroblasts of chicks. This effect is attributed to chelidonine while the two other chief alkaloids, chelerythrine and sanguinarine, possess no such property according to some authors, although others contradict this statement.

The plant is indigenous to Europe, with the exception of the Alps and the northern parts of Norway, Sweden, and Finland. Medicinal properites of celandine are mentioned in writings dated five centuries B. C., and the use of the plant has since been recommended for a great variety of pathologic conditions.

The author used for his experiments tumors produced by intraperitoneal injections of a suspension of cells of Ehrlich's mouse cancer. The success of transplantation depends on the number of cells in the ascitic fluid and can be evaluated by periodic weighing of the animals. Colchicin, urethan, trypaflavin, and arsenic were injected in control animals.

The author concludes from his experiments that chelerythrine displays an inhibitory effect on the growth of tumors with ascites in mice and that in this respect it is superior to chelidonine, sanguinarine, and chelidoxanthine. A significant prolongation of life expectancy after the administration of chelerythrine was observed only in exceptional cases.

—*Joseph K. Narat, M.D.*

The Humoral Effects of Metastasizing Carcinoid Tumors. P. J. D. SNOW, J. E. LENNARD-JONES, G. CURZON, and R. S. STACEY. *Lancet*, Lond., 1955, 2: 1004.

THE AUTHORS studied the cases of 3 patients with flushing associated with abdominal carcinomatosis and liver metastases, 2 of whom had histologically proved abdominal carcinoids. All 3 patients had abnormally high concentrations of 5-hydroxy-tryptamine (serotonin) in the blood, and 5-hydroxy-indoleacetic acid in the urine. This curious syndrome may also be associated with diarrhea and right-sided valvular lesions of the heart.

Some malignant carcinoids secrete 5-hydroxy-tryptamine. In these 3 patients, large amounts were present, and there was a general relationship between the severity of the symptoms and the amount of 5-hydroxy-tryptamine in the blood.

Diagnostic features were flushing, hepatomegaly, diarrhea, and increased urinary excretion of 5-hydroxy-indoleacetic acid.

—*S. Lloyd Teitelman, M.D.*

Do Relationships Exist Between the Blood Groups and Cancer? Studies of 2,145 Carcinoma Patients (Bestehen Beziehungen zwischen Blutgruppe und Karzinomerkrankung? Untersuchungen an 2,145 Karzinompatienten). GERD SCHRÖDER. *Arch. Geschwulstforsch.*, 1955, 8: 230.

THIS MATERIAL, representing chiefly patients from the city of Berlin, Germany, is broken down into blood groups and is then compared with the general percentages of the blood groups for the population of Berlin, as given by Schiff (*Klin. Wschr.*, 1926, 36: 1660). Thirty-five per cent of the general population of the city were of blood group O. The author's figure for his cancer patients was 35.9 per cent. For blood group A, the respective percentages were 44.0 per cent and 43.6 per cent; for group B they were 15.0 per cent and 15.2 per cent; for the group AB, they were 6.0 per cent and 5.3 per cent. Thus, any general effect

of the types of blood on the incidence of cancer is negated by these figures.

The author's observations are based on the study of 818 male patients and 1,327 females. When the material thus broken down with reference to sex was examined in tables for each type of carcinoma, certain differences were noted. For instance, of the 293 gastric cancers, 190 were in men and 103 were in women; in males the blood group A comprised 43.6 per cent, while in females group A comprised 53.5 per cent of the whole. Among the men with gastric cancer, those of group AB comprised a mere 4.2 per cent, while among the females with gastric cancer those of group AB comprised 10.7 per cent. These figures are at least significant, but it would be necessary to include them with a greater statistical material to arrive at valid conclusions.

In cases of esophageal cancer the elevation in the percentages was seen particularly in group O (40.9 per cent) of the male patients and in group B (18.5 per cent) of the females. The same increased incidence for the male patients in group O (38.1 per cent) and for the females in group B (22.8 per cent) is seen in bronchial cancer but there were only 5 female patients in group B. The number of females with mammary cancer was adequate for statistical purposes (278 cases), but in this group no valid statistical conclusions could be drawn. The same statement applies to the groups with uterine, ovarian and vulvar carcinoma.

Among the 243 patients with rectal carcinoma, those of group O were about equal with regard to sex, (51 males, 50 females). The percentage of males in this blood group (37.5 per cent) was higher than the expected figure (Schiff's 35.0 per cent), but the percentage of females (46.7 per cent) was surprisingly high. The last figure is considered of significance and with larger number of cases might lead to some statistically valid conclusions.

On the whole the material is too restricted and too varied to permit consideration of a relationship between the blood group and the development of carcinoma, but the author believes that further study is indicated in order to arrive at an eventual answer to the question.

In the determination of statistical certainty, the x^2 procedure of Pearson was employed.

—John W. Brennan, M.D.

Experience in the Measurement of Blood Loss and Fluid Loss at Operation. ANTHONY J. H. RAINS. *Brit. J. Surg.*, 1955, 43: 191.

RAINS has explored methods of measuring blood and fluid loss during operations. His initial interest was to find measures applicable to civil or military trauma, especially to provide a more accurate gauge for replacement than is now generally available. His report outlines the difficulties and discrepancies of the four methods applied by him, and he makes no final recommendations. Weighing swabs (used dry) was the easiest method used but it gave low values. Washing out saturated swabs and estimating their blood contents was not satisfactory, for technical reasons, and the results were uniformly too low. Weighing the patient requires too expensive and cumbersome apparatus, and is not applicable to routine clinical use. It is a more accurate method, but requires arbitrary corrections for insensible fluid losses and changes in weight caused by organ removal, dressings, ligatures, etc. Estimation of circulating blood volume by Evans blue dye dilution technique requires more precise attention to instrumentation, dosage, and accuracy of dye injection than is available in the surgical clinic. Furthermore, changes in blood volume may not reflect blood loss or gain, but simply pooling, or changes in blood volume which occur in sleep, under anesthesia, or in wakeful states.

Attention is called to a misleading belief that a pint transfusion is a pint of blood. As much as one-third of the bottle is citrate solution, and little account is given to amounts needed to fill the tubing system.

—Leonard D. Rosenman, M.D.

HOSPITALS; MEDICAL EDUCATION AND HISTORY

Zoografting; a Curious Chapter in the History of Plastic Surgery. THOMAS GIBSON. *Brit. J. Plast. Surg.*, 1955, 8: 234.

LIVING TISSUE taken from one animal and grafted on to an animal of another species is termed "heterograft." When the recipient is a human being, it is termed "zoograft."

The first reference to such a graft is found in the "*Observationes Medico-Chirurgicae*" of JOBUS A. MEEK'REN (1682), who reported that a part of a man's skull was replaced with that of a dog's; however, due to the religious prejudice of that period, this "successful graft" had to be removed under threat of excommunication.

Little more was heard of zoografting until the middle of the nineteenth century, when the twin innovations of anesthesia and antisepsis opened up new vistas in surgery. Heterografting was enthusiastically pursued both in the animal and in man, with numerous reports of great successes uncritically accepted. One astonishing claim was that of BRADFORD (1887) who reported that he transferred a rabbit's eye into the orbit of a man and that it retained its viability after a period of 2 months.

Skin, however, was the most widely employed tissue, and the essay is limited to this field. Many authors wrote with misplaced and extravagant enthusiasm, and even the best observers described as successful "takes" what we now know to be failures. It is of great interest to see why they were mistaken and to see, in the light of present-day knowledge, how completely erroneous deductions were made from correctly recorded facts.

Both free and pedicled grafts were used. Heroic attempts at parabiosis were made; one of these is well known—the uniting of a crow to a rat—which achievement attained a claim to posterity in an essay entitled "Physiological Cruelty," which appeared in the *Medical Times and Gazette* in 1860. Temporary adhesions between species were thus demonstrated and tried in man, first by SEDILLOT, in 1868, who united the skin of a dog's abdomen to a man's hand, an experiment which failed because of the dog's constant movement. In 1880, newspapers published an account of the ef-

forts of LEE, of Chicago, to unite by parabiosis the skin of a sheep to the back of a burned girl. The girl died on the sixth day as a result of her long illness, and amyloid disease, but the flaps were found to be firmly adherent at autopsy. Several other attempts ended in failure, and the procedure was not reported at any length in the literature, although rumor has it that many other unsuccessful attempts were made.

After REVERDIN popularized free skin grafting (autogenous) by his publication in 1869, another paper from this high authority in 1871 stated that skin for free grafts could be taken from other species and used successfully in man. Three years later, the report of a cure of 3 patients with leg ulcers by free zoografts from rabbits was considered for a prize by the "Academie." The enthusiasm spread, as did the list of donors, which soon included dogs, cats, rabbits, rats, and pigs among the mammals. The birds were represented by chickens, cockerels, pigeons and squabs; but most popular of all was the frog.

RANKING (*Lancet*, Lond., 1906) used frog skin on himself to cure an indolent leg ulcer, and was so well impressed that he subsequently used it in 300 to 400 cases with good results. MILES (1895) used frogs, rabbits, kittens, greyhound pups, and tried other materials such as peritoneum and circumcised prepuces. WOLFLER (1888) grafted a strictured urethra with mucous membrane from a prolapsed uterus, and transplanted mucous membrane from frogs, pigeons and rabbits with good results.

A long list of papers can be found on this subject, but references become fewer and fewer toward the end of the last century, and since the work of VORONOFF (1925) on rejuvenation by testicular transplant, little has been written. In all these, there was never any exposure of the fallacies of this method of skin grafting nor any denunciation of a most inferior mode of treatment. In retrospect, two questions remain to be answered: what did these writers expect to happen to their grafts, and what actually did happen?

Some thought that the grafted tissue might grow fur or feathers, depending on the donor; others believed that the contact of the graft with the granulation tissue caused the latter to be converted to epithelium, while one Glasgow professor of anatomy, in 1877, is said to have expressed the opinion that grafts supply one sexual element which fertilizes the epithelial elements at the edge of the ulcer and allows reproduction to take place, and, in so doing, gives rise to a new breed of skin.

What was the fate of the grafts? We know now that the grafts took temporarily, but were then lost in the same way as homografts in man. When this occurs, there is frequently left behind a thin film of connective and elastic tissue, which may be overgrown by host epithelium but is eventually removed by phagocytosis (GIBSON and MEDAWAR, 1943).

Critical examination of detailed reports on the zoografts reveals this process to have taken place with the loss of skin appendages, and pigment at an early stage. After a few days, then, the grafts were no more than acellular nonvital films of connective and elastic fibers. The successful reports of healing of stubborn ulcers may then be attributed to the growth of the patient's own epithelium under their protective layer, and to the factor that the extra care and cleanliness accorded the reputedly delicate grafts helped in this process.

Today, it would be quite unjustifiable to use living animal tissues as grafts in man, nor is it probable that they will ever be so used again; however, if zoografting had been successful, we might conjure up visions of satyrs, centaurs, mermaids, and human chimaerae of equally repulsive character. —*Carl Schiller, M.D.*